

To: Campbell, Ann[Campbell.Ann@epa.gov]
From: Gude, Karen
Sent: Fri 10/7/2016 3:21:10 PM
Subject: RE: Final PAG guidance (SAN 5198) to OP for OMB review

Just FYI -- CGP is close. It's going through OP management review now (through the first of three or so levels of management review), and likely will be ready to send to OMB by Tuesday...which is the date listed in ADP Tracker.

From: Campbell, Ann
Sent: Friday, October 07, 2016 11:17 AM
To: Gude, Karen <Gude.Karen@epa.gov>
Subject: RE: Final PAG guidance (SAN 5198) to OP for OMB review

Great. Thank you.

From: Gude, Karen
Sent: Friday, October 07, 2016 11:15 AM
To: Campbell, Ann <Campbell.Ann@epa.gov>
Subject: RE: Final PAG guidance (SAN 5198) to OP for OMB review

Oregon was sent to OP in advance of OMB on 10/4, so I wouldn't expect it to move to OMB quite yet.

CGP went to OP on 9/29...Per ADP Tracker, it looks like we're expecting it to move to OMB early next week. Sandy's going to give OP a quick call to see if she can get a status update on their review.

From: Campbell, Ann
Sent: Friday, October 07, 2016 11:07 AM
To: Gude, Karen <Gude.Karen@epa.gov>
Subject: RE: Final PAG guidance (SAN 5198) to OP for OMB review

Thanks. Do you know if uploaded Oregon or the CGP yet?

From: Gude, Karen
Sent: Friday, October 07, 2016 11:00 AM
To: Campbell, Ann <Campbell.Ann@epa.gov>
Subject: FW: Final PAG guidance (SAN 5198) to OP for OMB review
Importance: High

FYI – PAGs has been sent to OP.

From: Evalenko, Sandy
Sent: Friday, October 07, 2016 10:51 AM
To: Muellerleile, Caryn <Muellerleile.Caryn@epa.gov>
Cc: Arrigoni, Holly <Arrigoni.Holly@epa.gov>; Flaharty, Stephanie <Flaharty.Stephanie@epa.gov>; Gude, Karen <Gude.Karen@epa.gov>; Greene, Ashley <Greene.Ashley@epa.gov>
Subject: Final PAG guidance (SAN 5198) to OP for OMB review
Importance: High

Caryn: Attached is the Office of Water's submission of the Final Protective Action Guide for Drinking Water (PAG) (SAN 5198) for OMB review. I've attached Joel Beauvais' transmittal memo to Laura Vaught. Please let me know if you have any questions.

Thanks,

Sandy

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From: Cogliano, Gerain

Sent: Tue 6/30/2015 4:13:36 PM

Subject: Additional info re: Due to PARMS 7/8--Draft Drinking Water PAG for OSWER review - confidential

Draft Protective Action Guide 6-16-2015 OGWDW.DOCX

PAG DRLs Calcs for OSWER.XLSX

1Water PAG briefing for OSWER ODs 6-23-2015.docx

Hi all,

Some additional information has been shared that may aid in your review of the draft DW PAG (which is attached).

1. Attached is information from OW on derived concentrations for 3 radionuclides (I-131, Cs-137, & Sr-90) of interest in Table #1 of Section 7.
2. Attached is the briefing OGWDW presented to the OSWER ODs.
3. Below please find information regarding "an agreement" that was reached several years ago that should be considered when reviewing the draft DW PAG.

Link to the agreement document: <http://www.epa.gov/radiation/docs/er/pag-manual-interim-public-comment-4-2-2013.pdf>

See paragraph on page 53 as excerpted here:

Community involvement and sentiment are vital to this process. The stress from both the incident itself as well as the longer term effects of separation from home will be important factors as overall community health is considered. In the United States, a range of one in a population of ten thousand (10⁻⁴) to one in a population of one million (10⁻⁶) excess cancer incidence outcomes is generally considered protective for both chemical and radioactive

carcinogenic contaminant exposures. This range is the regulatory standard generally used in the context of EPA Superfund response actions. The NRC's decommissioning and decontamination process outcomes are usually in or near this range as well. A similar risk range may be an appropriate goal for radiological events that affect areas of comparable size. However, such risk ranges may not be practically achievable for major incidents that result in the contamination of very large areas. In making decisions about cleanup goals and strategies for a particular event, decision makers must balance the desired level of exposure reduction with the extent of the measures that would be necessary to achieve it, in order to maximize overall human welfare.

Also here's some additional information from the document that may be of interest:

See Section 3.5 (excerpt below) and Table **3.8. REENTRY MATRIX FOLLOWING A RADIOLOGICAL INCIDENT OR ACCIDENT**

3.5. PROTECTIVE ACTION GUIDANCE FOR FOOD AND DRINKING WATER

Information on food and animal feeds protective action guidance is contained in FDA's "Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies" (FDA 1998).

EPA is not proposing a specific drinking water PAG at this time. EPA has established enforceable drinking water standards for radionuclides under the Safe Drinking Water Act (SDWA). EPA recommends that to the extent practicable, emergency measures for drinking water be based on the National Primary Drinking Water Regulations (NPDWR) for Radionuclides. The Radionuclides Rule provides states with flexibility when responding to radiological events. If a public water system exceeds the radionuclides standard it must work to get back into compliance as soon as feasible. States have the authority to determine if other corrective actions are needed (e.g. providing alternative water).

However, the Agency recognizes a short-term emergency drinking water guide may be useful for public health protection in light of the Fukushima nuclear power plant accident, which impacted some Japanese drinking water supplies. Input on the appropriateness of, and possible values for, an intermediate phase emergency drinking water PAG is being sought during the public review of this Manual.

While the NPDWR provide for a regulatory standard of 4 mrem/year (beta, photon

emitters) based on life-time exposure, international organizations have developed technical approaches and methodologies that have produced a range of emergency guidelines related to drinking water (e.g., the World Health Organization²⁴, the International Atomic Energy Agency²⁵) as have other federal agencies (e.g., the Department of Homeland Security²⁶, the Food and Drug Administration²⁷) and non-federal organizations. EPA is seeking input on an approach and technical rationale for a drinking water PAG designed to help officials select protective actions under emergency conditions when exposures would occur over shorter time periods than those envisioned in the NPDWR.

Hopes this helps with your review!

From: Cogliano, Gerain

Sent: Thursday, June 25, 2015 9:30 AM

To: OSWER OD Deputies

Cc: Hilosky, Nick; Bergman, Shawna; Brooks, Becky; Stalcup, Dana; Fitz-James, Schatzi; Gardner, Monica; Raffaele, Kathleen; Hostage, Barbara; Parker, Robin; Brown, Sam; Baldwin, Mark; James, Kennetta; Scozzafava, MichaelE

Subject: Due to PARMS 7/8--Draft Drinking Water PAG for OSWER review - confidential

Importance: High

Good morning.

Attached is the draft Protective Action Guide for Drinking Water (17 pages) for our review. OW is asking that we provide comments by 7/14. As such, I will need your office's comments by 7/8 in order to consolidate comments and obtain AA IO review/input by the 14th. I would prefer comments in Track Changes mode. If you have any questions/concerns, please contact me. Thanks.

Gerain Cogliano

OSWER's Regulatory Steering Committee Representative

Policy and Regulatory Management Team Leader
Policy Analysis and Regulatory Management Staff (PARMS)
Office of Program Management (OPM)
Office of Solid Waste and Emergency Response (OSWER)

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For ADP information:
<http://intranet.epa.gov/adplibrary>
<http://intranet.epa.gov/oswer/policy/index.htm>

Draft Protective Action Guide (PAG) for Drinking Water

1.0 INTRODUCTION

This chapter presents protective action guides and planning guidance to protect the public in the event of a radiological incident that affects drinking water supplies. A PAG is the projected dose to an individual from a release of radioactive material at which a specific protective action to reduce or avoid that dose is recommended.

The protective action for the drinking water exposure pathway is to restrict the use of contaminated water for drinking purposes and to provide alternative drinking water for the affected community. The drinking water PAGs apply during the intermediate phase of an incident, which may last for weeks to months and up to one year.

2.0 SUMMARY 5 THE DRINKING WATER PAG

EPA is proposing a two-tier drinking water PAG be used during the intermediate phase following a radiation incident: 500 mrem (5 mSv) projected dose¹ over the course of a year for the general population (defined as anyone over age 15, excluding pregnant women and nursing women), and 100 mrem (1 mSv) projected dose over the course of a year for pregnant women, nursing women, and children age 15 and under.

EPA expects that any drinking water system adversely impacted during a radiation incident will take action to return to compliance with Safe Drinking Water Act (SDWA) levels as soon as practical. The proposed PAG is consistent with the other Protective Actions Guides currently in place for other media at the intermediate phase (i.e., the Food and Drug Administration's 500 mrem PAG for internal exposure from ingestion of food^{2,3}) and provides an additional level of protection for the most sensitive life stages.

This chapter explains how to calculate Derived Response Levels (DRLs) for radionuclides likely to appear in drinking water following a radiological contamination incident. DRLs are concentrations of radionuclides in drinking water that correspond to EPA's proposed PAGs of 100 mrem and 500 mrem. DRLs are essential because a PAG identifies a radiation dose rather than a quantity of radionuclides that can be measured directly in a medium such as drinking water. DRLs are expressed in units of pCi/L or Bq/L, and can be directly compared to measured radionuclide concentrations in drinking water supplies. In the absence of site-specific DRLs developed by emergency responders acquainted with local conditions, EPA recommends using these DRLs to guide actions to protect the public in the event of a radiological incident that affects drinking water supplies.

¹ All dose values expressed as Committed Effective Dose (CED).

² Food and Drug Administration (FDA). 1998. *Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations to State and Local Agencies*. Available online at: <http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>.

³ FDA. 2004. Supporting Document for Guidance Levels for Radionuclides in Domestic and Imported Foods. Docket No. 2003D-0558.

3.0 FACTORS EPA CONSIDERED WHEN ESTABLISHING THE DRINKING WATER PAG

Section 1.3.2 of the draft revised PAG manual⁴ provides the following three principles for establishing PAGs.

1. Prevent acute effects
2. Balance protection with other important factors and ensure that actions result in more benefit than harm
3. Reduce risk of chronic effects

The Agency crafted the drinking water PAG with these principles in mind. Specifically, consideration was given to the acute effects of exposure to radiation and lifetime risk of cancer based on age and drinking water intake. EPA made use of the risk conversion factors set forth in Federal Guidance Report No. 13 (FGR-13)⁵ and considerations of risk to the unborn set forth in National Council on Radiation Protection (NCRP) Report No. 174.⁶

In preparing this draft document, the Agency reviewed existing PAGs, thresholds, criteria and guidelines that have been established and proposed for protecting human health from a radiological incident, as discussed below. EPA also gave careful consideration to feedback received from public stakeholders on an earlier draft PAG manual,⁷ as it relates to public health protection from radiation exposure through drinking water.

The drinking water PAG was developed based on risks associated with ingesting drinking water contaminated with radionuclides. EPA also considered the potential radiation dose people could receive from various other uses of contaminated water, including showering, bathing, and dishwashing. In the United States, people typically shower, bathe, and wash dishes using the same source of water that they use to drink, but for the radionuclides of interest these activities generally represent much smaller risk than drinking contaminated water. Protection of a community's drinking water supply based on assumptions about ingestion will also protect the population from undue risk from contaminated drinking water by other routes of exposure.

4.0 RATIONALE FOR INTERMEDIATE PHASE DRINKING WATER PAG

⁴ EPA. 2013. Draft PAG Manual for Interim Use and Public Comment. Available online at: <http://www.epa.gov/radiation/docs/er/pag-manual-interim-public-comment-4-2-2013.pdf>.

⁵ EPA. 1999. Cancer Risk Coefficients for Environmental Exposure to Radionuclides. Federal Guidance Report #13. Available online at: <http://www.epa.gov/rpdweb00/docs/federal/402-r-99-001.pdf>.

⁶ Brent, R.L., Frush, D.P., Harms, R.W., and M.S. Linet. 2013. *Preconception and Prenatal Radiation Exposure: Health Effects and Protective Guidance*. National Council on Radiation Protection. Report #174.

⁷ Public feedback on the draft PAG Manual was requested in the Federal Register Notice Vol. 78, No. 72, p. 22257, April 15, 2013.

4.1 Rationale for establishing a two-tier PAG

In addition to a PAG of 500 mrem for the general population (i.e., anyone over age 15, excluding pregnant women and nursing women), EPA proposes establishing a more stringent PAG of 100 mrem to inform protective actions for pregnant women, nursing women, and children. Fetuses, infants, and children are at greater risk from radiological exposures than adults. This is due to the greater sensitivity of the developing body to the potential harmful effects of radiation and the longer dose commitment period for the longer-lived radionuclides that clear slowly from the body; a newborn that ingests radioactive material in water might be subject to the effects of that radiation for a longer period of time than an adult.

There are precedents for establishing a second, more protective threshold for radiological risks for younger members of the population due to the greater radiosensitivity of children versus adults. Following the Fukushima nuclear plant releases in 2011, the Japanese authorities set an emergency drinking water standard for infants that was one-third of the value for adults.⁸

PAGs and other guidance materials established by FDA for thyroid blocking with potassium iodide⁹ and for ingestion of food¹⁰ both include separate thresholds for more sensitive age groups.

Fetuses, infants, and children are not a homogenous group. There are considerable differences in the transmission of radiological drinking water contaminants to a fetus via the placenta, to an infant via formula, and to a child via direct consumption. There is also considerable variation in the sensitivities of various organs to radiological threats in developing bodies. Nevertheless, for the sake of making clear and executable decisions in the intermediate phase of emergency response, EPA proposes a single PAG for these more sensitive members of the population. Keeping PAGs relatively simple helps to minimize confusion during their implementation. Therefore, DRLs provided in Section 7.0 were selected by assessing risks to all age groups and choosing the most conservative concentration to the most sensitive age group.

4.2 Rationale for selection of PAG values

The PAG of 500 mrem (over one year) for the general population was selected to be consistent with the FDA food PAG¹¹ since many of the issues associated with selecting

⁸ World Health Organization (WHO). 2011. FAQs: Japan nuclear concerns. Page 9, water contamination. September 2011. Available online at: <http://www.who.int/hac/crises/jpn/faqs/en/index8.html>.

⁹ FDA. 2001. *Guidance: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies*. Available online at: <http://www.fda.gov/downloads/Drugs/.../Guidances/ucm080542.pdf>.

¹⁰ FDA. 1998 *Accidental Radioactive Contamination of Human Foods and Animal Feeds: Recommendations for State and Local Agencies*. <http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>

¹¹ FDA. 1998 *Accidental Radioactive Contamination of Human Foods and Animal Feeds:*

a food PAG also apply to selecting a drinking water PAG. It is also consistent with the guidance value of 500 mrem over one year established by the Department of Homeland Security as an intermediate-level PAG for drinking water interdiction.¹²

A PAG of 100 mrem (over one year) provides the most sensitive members of the population a reasonable level of protection from exposure to radioactivity in drinking water following a radiological incident. That value is comparable to the current public radiation protection standard of 100 mrem per year effective dose, as set forth in Nuclear Regulatory Commission (NRC) regulations (i.e., 10 CFR Part 20.1301). The International Commission on Radiation Protection¹³ recommends reference levels (acute or annual) in the range of 20 to 100 mSv (2,000 to 10,000 mrem) for protection of human health in emergencies, and in the range of 1 to 20 mSv (100 to 2,000 mrem) for occupational exposure, exposure by caregivers, or residential radon exposure. EPA's proposed drinking water PAGs are at the lower end of the latter range.

Following the Fukushima nuclear plant releases in 2011, there was concern about levels of radioactive Iodine-131 (I-131) in drinking water. The Japanese authorities applied a two-tier set of provisional emergency standards to I-131 in water: 300 Bq/L (about 8,100 pCi/L) for adults, and 100 Bq/L (about 2,700 pCi/L) for infants (specifically for drinking water used to prepare baby formula). According to informational materials assembled by the World Health Organization in the wake of the incident,¹⁴ these emergency drinking water standards were provisional regulation values established by the Japanese Food Sanitation Act, as indicated by the Nuclear Safety Commission of Japan. These standards were precautionary and took international guidance into consideration, including recommendations of the International Atomic Energy Agency and the International Commission on Radiological Protection. The infant standard, furthermore, was equivalent to the international guideline set by Codex Alimentarius¹⁵ for infant food.

Under the Safe Drinking Water Act (SDWA), the Agency established maximum contaminant levels (MCLs) for radiological contaminants in drinking water. The National Primary Drinking Water Regulations (NPDWR) for radionuclides, set forth in 40 CFR 141, effectively adopt a dose-based limit of 4 mrem/yr for beta particle and photon radioactivity. These requirements are based on lifetime exposure criteria, which assume 70 years of continued exposure to contaminants in drinking water. The Agency determined that it is not appropriate to base protective actions during short-term emergency incidents on lifetime exposure criteria. While the SDWA framework is appropriate for day-to-day normal operations, it does not provide the necessary tools to

Recommendations for State and Local Agencies.

<http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>

¹² See Table 1 in 73 FR 45029, <http://www.gpo.gov/fdsys/pkg/FR-2008-08-01/pdf/E8-17645.pdf>.

¹³ International Commission on Radiological Protection (ICRP). 2007. *The 2007 Recommendations of the International Commission on Radiological Protection*, Annals of the ICRP, Volume 37, Nos.2-4, 2007, Publication 103, ISSN 0146-6453, ISBN 978-0-7020-3048-2, pp. 96-98

¹⁴ WHO. 2011.

¹⁵ <http://www.codexalimentarius.org/about-codex/en/>.

assist emergency responders with determining the need for an immediate protective action. However, regardless of the cause of an incident, EPA expects that any drinking water system impacted during a radiation incident will take action to return to compliance with the National Primary Drinking Water Regulation (NPDWR) levels by the earliest feasible time.

5.0 INTERPRETING AND APPLYING THE PAG

The drinking water PAG is intended primarily to guide planning and decision-making efforts by local and state officials, including drinking water providers, during the intermediate phase of a radiological emergency when water supplies are particularly vulnerable to contamination from deposition of radioactive material from the atmosphere. Actions to protect water supplies may be implemented at other levels and at any time following a radiological incident, and even before an anticipated release occurs. The goal is to keep the dose to the public as low as reasonably achievable. Radiation doses should be reduced to below SDWA MCLs as soon as practicable.

5.1 Interpreting the two-tier PAG

EPA is proposing a two-tier PAG: 500 mrem for the general population (anyone over age 15, excluding pregnant women and nursing women) and 100 mrem for pregnant women, nursing women, and children.

Authorities have flexibility on how to apply the PAG. In some cases they may find it prudent to use the PAG of 100 mrem as a target for the whole population, while in other circumstances, authorities may find that it makes sense to use both targets simultaneously. For example, emergency managers can use a two-tiered approach to focus on protecting the most sensitive population with limited alternate water resources. If bottled water must be rationed, for example, authorities may make the bottled water available to children, pregnant women and nursing women, and instruct the rest of the population to use a public drinking water supply that will satisfy the 500 mrem PAG.

As stated above, the PAGs are intended as guidance, and local authorities should take into account local circumstances (e.g., incident scope and community needs) when implementing a course of action to protect the public.

5.2 Operationalizing PAGs as Derived Response Levels (DRLs)

The PAG specifies a radiation dose to avoid via drinking water exposure over the course of a year. In order to determine whether a PAG should be implemented, authorities will need to establish a relationship between the concentration of one or more radionuclides in a drinking water source and the radiation dose members of the population might experience as a result of drinking contaminated water. Incident-specific factors that may be taken into consideration include:

1. The radionuclides of concern
2. The rate and timing of entry of the radionuclides into a drinking water supply, via

- atmospheric deposition or by other means
3. The rate of natural attenuation of the radionuclides
 4. The potential estimated duration of public exposure to contaminated drinking water
 5. The estimated daily consumption of contaminated drinking water

Those responsible for implementing PAGs will need to convert PAGs into Derived Response Levels (DRLs) in units of Bq/L or pCi/L. Section 7.0 of this document provides DRLs and explains how they can be calculated. Selected dose conversion factors and standard estimates of daily drinking water consumption for various age groups are also provided, along with references to informational resources.

While the PAG Manual is primarily for advance planning, there are specific radionuclides, including Cs-137, I-131, and Sr-90/Y-90, that are of particular interest for radiological incident scenarios where drinking water sources might be contaminated. Section 7.0 presents default DRLs for these radionuclides to aid emergency managers in making water restriction decisions involving these contaminants. DRLs for these radionuclides are presented as examples for purpose of illustration. If other radionuclides are present, DRLs should be calculated using the same methodology, as discussed in Section 7.0.

5.3 Practical Considerations

After deposition has ended, radionuclide concentrations present in a water supply may decline at rates determined by half-lives of the individual nuclides, or may decline faster by dilution with uncontaminated water, or may even increase after rainfall events. The concentration of radionuclides in drinking water as a function of time after the incident can be estimated or modeled based on knowledge of the incident, including radionuclide sources and the properties of the drinking water supply. Such estimates should be validated by monitoring or sampling, as discussed in Section 6.1.

Unlike naturally-occurring radionuclide contamination of drinking water from minerals present in geological formations, ground water supplies are expected to be less vulnerable to contamination from radionuclide releases than surface water supplies, but this should be confirmed by monitoring or sampling. The potential for ground water to become contaminated will greatly depend on whether the ground water resource is close to the surface or is from a deep aquifer bounded by an aquitard, as well as on rainfall rate and the composition of the overlying soil (which will affect the rate at which contaminants deposited on soil will migrate to the ground water resource).

A PAG is intended as a point of reference to aid emergency response managers in their decision-making. After a particular situation stabilizes and becomes more clearly defined, local authorities may wish to modify the level of drinking water exposure they consider to be appropriate in order to implement longer-term dose reduction strategies. Decision makers may also want to consider lower dose levels for a drinking water PAG,

depending on available resources and needs of an individual community. EPA expects that any drinking water system adversely impacted during a radiation incident will take action to return to compliance with NPDWR levels as soon as practicable but no more than one year following the incident.

Section 6.3 discusses actions that authorities can take to prevent drinking water radiation doses from exceeding PAG levels. Because radionuclides decay over time, early interventions such as restricting use of contaminated water immediately after the incident may be most effective in reducing the total radiation dose to the population. Such decisions may need to be made based on limited information. Authorities may find it prudent to take such action even before field sample measurements or modeled estimates of radiation dose have been calculated and validated.

6.0 PLANNING AND TAKING ACTION

This section discusses actions that state and/or local authorities and drinking water utilities can take to protect the public in the event that a water supply is affected by a significant radiological contamination incident. This section does not constitute a complete handbook for radiological emergency response, but it describes considerations that can be included in comprehensive emergency planning at the state, local and utility level. Actions that public authorities and/or drinking water providers should take include water monitoring (described in Section 6.1), public notification (described in Section 6.2), and mitigation measures to protect the water supply and the water-consuming public (described in Section 6.3). Preventive action, such as temporary closure of water system intake valves to prevent a contaminant plume from entering the system, may be taken in advance of an anticipated release; it is not necessary to wait until drinking water contamination exceeds PAG levels. Emergency response plans need to consider whether sufficient storage capacity is available to support the community's fire suppression and sanitation needs while the intake valves are closed.

Emergency planning provides the opportunity to develop state, local and utility-specific plans and implementation procedures that reflect the unique needs of a particular community. Advance planning can provide clarity and facilitate the decision-making process during a radiological emergency.

6.1 Monitoring and Characterization of Contaminants

A comprehensive radiological surveillance program that monitors concentrations of radionuclides of interest in both source water and finished drinking water will provide an indication of whether any protective action is necessary or if the actions being taken are effective.

The NPDWR for radionuclides requires community water systems (CWSs) to conduct monitoring at each entry point to the distribution system to ensure that every customer's

water does not exceed the MCLs for radionuclides.¹⁶ All CWSs are required to monitor for gross alpha, radium-226/228, and uranium. In addition, CWSs designated by the state as “vulnerable”¹⁷ and those using waters “contaminated”¹⁸ by effluents from nuclear facilities must also conduct monitoring for beta particle and photon radioactivity. If a water system is directed by the primacy agency to collect samples for compliance purposes, approved analytical methods must be used.

In the event of a radiological contamination incident, state officials may require public water systems to immediately collect additional samples for radionuclides, including beta particle and photon activity. However, the Agency recognizes that during an emergency situation it may be necessary to identify alternative sampling and analytical approaches to obtain data to inform short-term actions by emergency response personnel. Many states have established Radiological Emergency Preparedness programs designed to guide sample collection and analysis and to advise emergency managers in a radiological emergency. Additionally, the Federal Radiological Monitoring and Assessment Center (FRMAC) can deploy monitoring and sampling field teams and provide dose assessment expertise to assist states and local communities in responding to an emergency. See the National Response Framework, Nuclear/Radiological Incident Annex¹⁹ for information on roles and capabilities.

EPA provides rapid laboratory analysis methods for selected radionuclides to expedite the analytical turnaround time while simultaneously meeting measurement quality objectives.²⁰ Emergency planning can help to prepare for challenges that may arise from variability in environmental matrices and achieving sample representativeness and homogeneity relative to routine samples.

If members of the public are served by drinking water from household cisterns or private wells, local officials should consider how monitoring should be undertaken to determine levels of target radionuclides and assess the risks posed to these populations.

6.2 Public Notification

An emergency response plan should include a strategy for keeping the community informed of the actions being taken by authorities and ensuring that local officials and emergency responders understand their respective roles and responsibilities. This includes communicating to customers of PWSs and (if applicable) to those who rely on

¹⁶ For more information about monitoring requirements for the Radionuclides Rule see the “Radionuclides Rule: A Quick Reference Guide” (EPA 816-F-01-003, June 2001) or “Implementation Guidance for Radionuclides” (EPA 816-F-00-002, March 2002).

¹⁷ For more information see 40 CFR 141.26(b)(1).

¹⁸ For more information see 40 CFR 141.26(b)(2).

¹⁹ Document is available online at: <http://www.fema.gov/media-library/assets/documents/25554>

²⁰ EPA. 2014a. Rapid Radiochemical Methods Applicable to Selected Radionuclides for Environmental Remediation Following Radiological Incidents. Third Edition. Front matter available online at: <http://www.epa.gov/narel/Docs/Preface%20to%203rd%20Edition%20%28Online%29%2004-16-14.pdf>. Rapid methods are available online at: http://www.epa.gov/narel/rapid_methods.html

household cisterns and private wells. It is critical for water utilities to participate in the emergency response planning activities.

If compliance monitoring indicates that contamination levels exceed the MCL for any radionuclide, water systems are required to issue public notice on a “Tier 2” time frame (i.e., as soon as practical, but no later than 30 days after the system learns of the violation). . However, States may determine that the notification requirement should be elevated to a “Tier 1” Public Notification (i.e., as soon as practical, but no later than 24 hours) based on a significant potential for serious adverse effects on human health due to short-term exposure.²¹

During a response to a radiological event, water systems may have difficulty with issuing public notifications in addition to managing the response to the contamination event. The state may issue public notification on behalf of the water system (40 CFR 141.210(a)). This would allow the state to deliver a consistent message to all affected customers and allow the system to concentrate its efforts on returning to operation or returning to compliance in the event of a radionuclides MCL violation. For more information see the Revised Public Notification Handbook (EPA 816-R-09-013, March 2010).

State and local authorities should be proactive in communicating about risks and uncertainties and providing clear instructions to the public. For any incident response requiring coordinated federal support, refer to the National Response Framework and Emergency Support Function 15, External Affairs Annex, for roles and response protocols.

6.3 Additional Actions to Reduce Levels of Contamination

In the initial phase following a radiological incident, officials are advised to take reasonable precautionary measures to protect water supplies as soon as notification of a radiological release or impending release is received. As data are obtained from monitoring programs (including sampling and analysis of water upstream and downstream of a water system intake structure and within the distribution system) and observed concentrations are benchmarked against derived response levels (DRLs) calculated from the PAGs, officials can make informed decisions about the need to implement protective actions in the intermediate phase. Water system officials should be in close communication with their primacy agency (e.g., state/county regulators) prior to taking protective actions.

Options available to water systems to reduce radiation dose to drinking water customers during the intermediate phase include applying treatment technologies, relying on back-up storage, blending water, accessing alternative water supplies, and rationing of uncontaminated water. Examples of these options are described briefly below.

²¹ For more information see 40 CFR 141.202(a), Table 1(9), Special public notices: Occurrence of a waterborne disease outbreak or other waterborne emergency.

Technical and economic burden on smaller systems may be reduced by pooling resources with other water systems (e.g., establishing interconnections, sharing technical and operator staff, and sharing of supplies and equipment). As part of emergency planning efforts, local officials should consider the possibility of temporary rationing of uncontaminated or treated water if supplies are inadequate to meet normal demand.

Many of these options require advanced planning. Guidance on developing emergency drinking water supplies is available from EPA.²² The Centers for Disease Control and Prevention also provide resources and guidance for establishing emergency water supplies and communicating water advisories to the public.²³

6.3.1 Treating Contaminated Water

Systems can treat contaminated water to reduce elevated radionuclide levels. Four treatment technologies are classified by EPA as Best Available Technologies (BATs) for removing radionuclides from drinking water: coagulation/filtration, ion exchange, lime softening, and reverse osmosis. EPA has also listed these BATs as Small System Compliance Technologies (SSCTs) for radionuclides treatment, along with less commonly used techniques such as green sand filtration, co-precipitation with barium sulfate, electrodialysis/electrodialysis reversal, pre-formed hydrous manganese oxide filtration, and activated alumina. Further information on radionuclide treatment options is available from EPA.²⁴

Removal efficiency for specific radionuclides will vary across available technologies and may depend on technology-specific parameters (e.g., ion exchange effectiveness depends on pH, resin selected, and presence of other ions). In addition, liquid and solid treatment residuals with elevated radiation levels may have special disposal requirements. Disposal options may vary from one jurisdiction to another, and may depend on the type, concentration and volume of residuals. Further information on residual disposal considerations is available from EPA.²⁵

6.3.2 Temporarily Closing Intake Valves

If the deposition of radionuclides into a river is limited in duration, only a portion of the

²² EPA. 2011b. *Planning for an Emergency Drinking Water Supply*, EPA 600/R-11/054, June 2011.

²³ CDC. 2014. Drinking Water Advisory, Planning, & Emergency Response Resources. Available on the Internet at: <http://www.cdc.gov/healthywater/emergency/drinkingwateradvisory.html>. Last updated December 2, 2014.

²⁴ EPA. 2015a. Radionuclides in Drinking Water -- Compliance Options: Treatment Technology Descriptions. Available on the Internet at: <http://cfpub.epa.gov/safewater/radionuclides/radionuclides.cfm>. See also EPA. 2002a. *Radionuclides in Drinking Water: A Small Entity Compliance Guide*. EPA 815-R-02-001 (http://www.epa.gov/safewater/radionuclides/pdfs/guide_radionuclides_smallsystems_compliance.pdf).

²⁵ EPA. 2006a. *A System's Guide to the Management of Radioactive Residuals from Drinking Water Treatment Technologies*. EPA 816-F-06-012, August 2006. See also EPA. 2006b. *A System's Guide to the Identification and Disposal of Hazardous and Non-Hazardous Water Treatment Plant Residuals*. EPA 816-F-06-011, August 2006.

water may become contaminated. A water system with enough storage capacity can temporarily close its intake valves and allow the contaminants to flow past the intake to prevent contamination from entering the distribution system.

If stored water supplies are not sufficient to meet community fire suppression and sanitation needs while intake valves are closed, the system could take other actions discussed in this section, including supplementing water supplies with alternate sources or implementing water use restrictions.

6.3.3 Establishing Interconnections to Neighboring Systems

If the water system is part of a larger, regional supply system, existing interconnections to an uncontaminated neighboring water supply could be activated. It might also be possible to construct temporary pipelines on an impromptu basis.

If this option is implemented, steps should be taken to prevent backflow from the contaminated system. Care will also need to be taken to ensure that the supply of water and treatment capacity at the uncontaminated system will adequately serve the larger population.

6.3.4 Blending Water Sources

If a source of uncontaminated water is available, a water system may choose to blend water from contaminated and uncontaminated sources of drinking water. The water may be blended using storage tanks or a common header to allow for complete mixing prior to distribution to customers.

6.3.5 Importing Water in Tanker Trucks

Under some circumstances (e.g., difficult terrain, urgent need), it may be more efficient or expedient to temporarily transport clean water by truck, rail, or barge to distribution centers in the affected community than to lay down pipelines. State and local departments of public health, as well as emergency management agencies, typically have standards and requirements related to hauling water. Water systems would benefit from having procedures for importing water in tanker trucks documented in an emergency response plan. All water systems importing water by tanker should verify that their plan adheres to state and local requirements. If the water system's distribution system is not being used to provide the imported water, the needs of residents with limited transportation options and physical disabilities should be taken into account when selecting locations for distribution centers. The availability of suitable transport vehicles may limit use of this option.

6.3.6 Importing Bottled Water

Providing bottled water to the affected community is another possible option during an emergency situation. The water may come from a nearby water system or from a water bottling company. This option may be cost-effective during an emergency if water is

needed quickly and if the length of the emergency does not require long-term action, such as the construction of an interconnecting pipe.

7.0 DERIVED RESPONSE LEVELS (DRLs)

EPA developed the radionuclide-specific DRLs by calculating the radionuclide concentrations in drinking water that would result in projected radiation doses of 100 and 500 mrem dose, assuming one year of continuous exposure and average drinking water intake rates for children and adults.

Several considerations should be kept in mind when using these pre-calculated DRLs. The DRLs presented in Table 1 are calculated on the assumption that each radionuclide is the only radionuclide present in drinking water. DRLs are additive. In situations where multiple radionuclides are present, DRLs should be combined using a sum of fractions approach to ensure that the projected dose does not exceed the PAG of 100 or 500 mrem. (An example calculation is provided in Section 7.1.) Table 1 does not present DRLs for all radionuclides that may occur in drinking water following a contamination incident.

These DRLs were calculated using a simplifying and conservative assumption that radionuclide levels will remain constant over the course of one year. This provides an added level of protection in light of the many unknowns involved in an emergency. In fact, after the initial deposition event has occurred, concentrations may decline at rates determined by the half-lives of individual isotopes, or decline faster due to dilution with uncontaminated water, or could even increase after rainfall or subsequent deposition events. Some nuclides, like I-131, have half-lives measured in days, while others, like Cs-137, have half-lives measured in years. Early exceedance of the DRL does not preclude the possibility that doses will stay below PAGs as radionuclide concentrations in water decline by a combination of radioactive decay and natural attenuation. If the concentrations of radionuclides do not exceed DRLs over the course of one year, doses will remain below the PAG.

Table 1. Derived response levels (DRLs)²⁶ -- Drinking water concentrations corresponding to specified doses (mrem) of select radionuclides, assuming one year of exposure at constant levels²⁷

	DRLs for pregnant women, nursing women, and Children Age 15 and Younger – 100 mrem Dose	DRLs for adults (excluding pregnant women and nursing women) – 500 mrem Dose

²⁶ Values provided in this table have been rounded.

²⁷ The calculated values provided in this table are intended to illustrate the methodology and conservative assumptions EPA believes are adequate to provide a reasonable level of protection to sensitive populations. Additional information including, updated dose conversion factors, calculation methodologies as well as other comprehensive information regarding DRL development will be appended to the FRMAC Assessment Manual.

Sr-90/Y-90 ²⁸	1,000 pCi/L	7,400 pCi/L
Cs-137	6,140 pCi/L	16,570 pCi/L
I-131	1,300 pCi/L	10,340 pCi/L

The DRLs provided in Table 1 were derived by calculating life stage-specific DRLs (as described in section 7.2) for six different ages (Infant, 1, 5, 10, 15, and adults). For the most sensitive life-stages (children age 15 and younger), the most protective/lowest radioactivity result was selected as the DRL. The calculated values differ across individual life-stages because each age group has a different dose conversion factor and drinking water ingestion rate. For example, in the 15-and-younger category, the most limiting concentration for I-131 is for the 5 year old and the most limiting concentrations for Sr-90/Y-90 and Cs-137 are for the 15 year old.

7.1 Combining DRLs for Multiple Radionuclides

If multiple radionuclides are present in the water supply, then it is recommended that the obtained concentrations of each radionuclide be divided by the provided DRL values. This provides a fraction of the allowed concentration (and the projected dose) for each radionuclide. If the sum of the fractions is less than 1, the total dose is assumed to be below the PAG values. Emergency response personnel may need to calculate the sum of fractions on an ongoing basis, as the concentrations of individual radionuclides may change over time. The sum of the fractions is expressed as follows:

$$F = \sum (C_i / \text{DRL}_i)$$

Where:

F = sum of the fractions

C_i = the concentration of radionuclide i in the water supply (pCi/L or Bq/L)

DRL_i = derived response level for the i^{th} radionuclide (pCi/L or Bq/L)

For example, if Sr-90/Y-90 and Cs-137 are the only radionuclides present in the drinking water, and Sr-90/Y-90 are present at 1,540 pCi/L and Cs-137 is present at 10,600 pCi/L, the combined dose exceeds the PAG of 100 mrem for fetuses, infants, and children:

²⁸ Y-90 is a radioactive decay product of Sr-90 and will normally be found alongside Sr-90 in the case of a Sr-90 release; therefore they are treated together. Solubility differences may cause less Yttrium to be present, however it is a conservative assumption to include both in DRLs. When calculating the combined DRL, note that the dose coefficients (see Table 3) are additive.

$$\begin{aligned}
 F &= \sum (C_i / DRL_i) \\
 &= (1,540 \text{ pCi/L} / 1,000 \text{ pCi/L}) + (10,600 \text{ pCi/L} / 6,140 \text{ pCi/L}) \\
 &= 1.54 + 1.73 \\
 &= 3.27
 \end{aligned}$$

3.27 > 1, so the PAG is exceeded.

The same concentrations do not exceed the PAG of 500 mrem for adults:

$$\begin{aligned}
 F &= \sum (C_i / DRL_i) \\
 &= (1,540 \text{ pCi/L} / 7,415 \text{ pCi/L}) + (10,600 \text{ pCi/L} / 16,570 \text{ pCi/L}) \\
 &= 0.21 + 0.64 \\
 &= 0.85
 \end{aligned}$$

0.85 < 1, so the PAG is not exceeded.

7.2 Calculation of DRLs

DRLs may be calculated with the help of the following equations.

The quantity of radionuclide i ingested by age group a over a given time period, T , is calculated as follows.

$$I_{iaT} = C_i \times \text{Ing}_a \times T$$

Where:

- I_{iaT} = The total intake of radionuclide i for age group a (in pCi or Bq) over time period T .
- C_i = The concentration of radionuclide i in drinking water (in pCi/L or Bq/L). A simplifying assumption is made that the concentration of the radionuclide is constant over the time period T .
- Ing_a = The daily ingestion rate of water for age group a , in L/day. See Section 7.3 for guidance on daily water ingestion rates.
- T = The time period that the population is drinking contaminated water (days). In this analysis, the time period of interest is 365 days.

The dose (mrem or Sv) due to the ingestion of radionuclide i to age group a over time period T is calculated as follows:

$$D_{iaT} = I_{iaT} \times DCF_{ia}$$

Where:

- D_{iaT} = Dose (in mrem or Sv) due to the ingestion of radionuclide i to age group a over time period T
- I_{iaT} = The total intake of radionuclide i for age group a (in pCi or Bq) over time period T
- DCF_{ia} = The dose conversion factor (also referred to as dose coefficient) for the ingestion of radionuclide i in drinking water and age group a (in mrem/pCi or Sv/pCi, or mrem/Bq or Sv/Bq). See section 7.4 for guidance on DCFs.

For each age group a and radionuclide i , substituting the applicable PAG for the dose D_{iaT} and then solving for C_i yields the applicable DRL.

7.3 Water Ingestion Rates

Table 2 presents mean values for tap water consumption taken from the CD supplement to FGR-13.²⁹ Other sources of estimated drinking water ingestion rates are available (e.g., EPA's *Exposure Factors Handbook*³⁰), but the ingestion rates presented in FGR-13 were specifically designed with corresponding age ranges to be used in conjunction with other data from FGR-13. Values are provided for males and females in various age groups. Since the ingestion rates for males are higher (and therefore more conservative) than those for females, EPA elected to use the intake values for males to represent each age group in the calculation of DRLs in Table 1. In addition, for the calculation of the adult DRL, EPA made the conservative assumption that the ingestion rate would be assigned the highest value within the adult category, the 50 year old male, at an estimated 1.643 L/day.

Table 2. Mean Drinking Water Ingestion Rates from FGR-13

Age (years)	Tap Water (L/day)	
	Male	Female
0	0.191	0.188
1	0.223	0.216
5	0.542	0.499

²⁹ EPA. 2002b. Federal Guidance Report 13. Cancer Risk Coefficients for Environmental Exposure to Radionuclides: CD Supplement, EPA-402-C-99-001, Rev. 1.

³⁰ EPA. 2011a.

10	0.725	0.649
15	0.900	0.712
20	1.137	0.754
50	1.643	1.119
75	1.564	1.179

Source: CD Supplement to FGR-13, Table 3.1.

7.4 Dose Coefficients, or Dose Conversion Factors (DCF) (Sv/Bq Ingested)

The effective whole body dose per Bq ingested of various radionuclides in water, for various age groups, can be found on the CD supplement to FGR-13.³¹ These dose conversion factor (DCF) values apply to both males and females. Table 3 presents DCFs for a few representative radionuclides of interest, converted to US units for convenience.

Table 3. Dose Conversion Factors³²

Age	DCFs (mrem per pCi ingested), from FGR-13			
	Sr-90	Y-90	Cs-137	I-131
Infant (100 day old)	8.40E-04	1.16E-04	7.79E-05	6.82E-04
1 year old	2.68E-04	7.41E-05	4.58E-05	6.62E-04
5 year old	1.73E-04	3.69E-05	3.58E-05	3.83E-04
10 year old	2.21E-04	2.18E-05	3.75E-05	1.94E-04
15 year old	2.92E-04	1.24E-05	4.95E-05	1.27E-04
Adult	1.02E-04	9.94E-06	5.02E-05	8.05E-05

Source: CD Supplement to FGR-13.

³¹ EPA. 2002

³² The DCFs in this table show the variation across age groups and nuclides and are provided to illustrate the conservative methodology and assumptions EPA believes are adequate to provide a reasonable level of protection to sensitive populations. Additional information including updated dose conversion factors, calculation methodologies as well as other comprehensive information regarding DRL development will be appended to the FRMAC Assessment Manual.

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From: Steuteville, William
Sent: Thur 12/22/2016 7:18:03 PM
Subject: Comments on Northern Lights 2016
[ESF10 Feedback on Northern Lights 2016 WDS 11-8-16.docx](#)

Hi Sam, Jason,

I was pleased to participate in Northern Lights 2016. Attached are my comments. I previously discussed these with Gene Jablonowski. Sorry it took me so long to commit them to writing.

Enjoy the holidays!

Thanks Bill

Bill Steuteville

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From: Dennis Carney
Sent: Tue 12/20/2016 12:12:00 AM
Subject: RE: Agenda for Tomorrow's Radiation Call with the Regions - 12/20/16
Top 10 Qs for OSCs Responding to Radiation Sites.docx

John, Sounds good..... Earlier works better for me as I have some things scheduled starting at 11.....

Attached is the consolidated list of potential questions we rec'd to date. I had planned on sorting into "categories", if possible but never got to that.

Thanks, dennis

Dennis P. Carney

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Scientific Minds. Common Sense Solutions.

From: Cardarelli, John [mailto:Cardarelli.John@epa.gov]
Sent: Monday, December 19, 2016 2:51 PM
To: Dennis Carney
Subject: FW: Agenda for Tomorrow's Radiation Call with the Regions - 12/20/16
Importance: High

FYI...

Let's touch base sometime tomorrow morning.

...John

From: Ferguson, Rafaela

Sent: Monday, December 19, 2016 2:46 PM

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Subject: Agenda for Tomorrow's Radiation Call with the Regions - 12/20/16
Importance: High

Good Afternoon Everyone,

The agenda for tomorrow's call is attached. Talk to you at 12:00 noon ET. Call-in # and access code are at the top of the agenda.

Rafie

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From: Ferguson, Rafaela
Sent: Mon 12/19/2016 7:45:54 PM
Subject: Agenda for Tomorrow's Radiation Call with the Regions - 12/20/16
[Revised Agenda for Reg Rad Call Dec 20.docx](#)

Good Afternoon Everyone,

The agenda for tomorrow's call is attached. Talk to you at 12:00 noon ET. Call-in # and access code are at the top of the agenda.

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[RAD SOG Ver2-FINAL.pdf](#)

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FINAL

US EPA Region 10
Radiological Incident Response
Standard Operating Guidelines

Version 2.0



May 2014

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The information provided within this document is NOT intended to be policy or to be prescriptive and may be modified as appropriate with subsequent updates by EPA START Region 10. The document is designed to be generic and generalized, and it is expected that spill response managers will modify as appropriate to the conditions of each incident.

Acronyms

cpm	Counts per minute
DAC	Derived air concentration
DHS	Department of Homeland Security
DoD	Department of Defense
DOE	Department of Energy
dpm	Disintegrations per minute
EPA	Environmental Protection Agency
GM	Geiger-Mueller
HP	Health Physicist
mR/hr	milliroentgen per hour
NASA	National Aeronautics and Space Administration
NRC	Nuclear Regulatory Commission
OSC	On-Scene Coordinator
PPE	Personal Protective Equipment
RDD	Radiological Dispersion Device
rem	Roentgen equivalent man
RERT	Radiological Emergency Response Team
RSO	Radiation Safety Officer
SOG	Standard Operating Guide
SSO	Site-Safety Officer
START	Superfund Technical Assistance and Response Team
μR/hr	microroentgen per hour

Radiological Incident Response Guidelines

PURPOSE: These standard operating guidelines (SOG) serve as a companion to the Region 10 Radiological Emergency Response Decision Tree. A primary purpose of the decision tree and SOG is to establish radiological screening guidance for any response scenario for which radiation is known or suspected onsite. In addition, this SOG explains in greater detail, and provides a rationale for, the activities described in any branch of the decision tree. A copy of the decision tree is located in Appendix A.

This SOG is intended for use by EPA staff and START contractors who have received basic training in radiological response. It is not intended for use in unique radiological events such as those involving a radiological dispersion device (RDD) or any type of nuclear incident (improvised devices, reactor failures, etc.).

Decision Point 1: Is Radiation Known or Suspected?

Use of the Radiological Emergency Response Decision Tree assumes that initial notification has occurred. Responders should be concerned with acquiring information prior to indicating if any radiological materials are at the site. Information indicating the potential for radioactive materials to be present may include; placarding or signage, first responder instrumentation, physical location of the incident, etc. Generally, during the notification process, the appropriate information will have been gathered and relayed to responders preparing for mobilization.

BEST PRACTICE: Always acquire background radiation readings when mobilizing to or upon arriving at a site to compare to values acquired later during exclusion zone screening.

- ☐ If the presence of radiation is not known or suspected, mobilize to the site with a recon kit. See Table 5 or the Decision Tree key for basic kit components for more detailed information.
 - Upon arrival at the site and after routine site preparation has been completed acquire a background reading using a gamma detector. See Appendix C for details on acquiring background readings.
 - Survey the exclusion zone with at minimum a gamma detector, then proceed to Decision Point 2.
- ☐ Based on the available information, if radiation is known or suspected, immediately contact a Health Physicist (HP) to assist in health and safety considerations and provide guidance on next steps for mobilization. Proceed to Decision Point 3.

Appendix C provides guidance on performing background surveys and other types of field radiation surveys.

Decision Point 2: Is Radiation Detected?

This branch of the decision tree assumes that radiation was not suspected on-scene. Regardless, of whether radiological materials are known to be present, all EPA/START Region 10 responders shall deploy with tools capable of verifying the presence of ionizing radiation and will perform at least baseline screening of the exclusion zone to ensure no radiation is detected.

- ☐ Based on information gathered during initial site surveys, if no radiation is detected above thresholds described below, discontinue use of this decision tree and resume typical response operations.
- ☐ If radiation is detected at levels exceeding 330 counts per minute (cpm) on a Geiger-Mueller (GM) tube or sustained readings above 100 microroentgens per hour gamma (see Table 4c), back out of the exclusion zone, consult an HP, and request additional resources based on the type of radiation determined by the survey. Proceed to Decision Point 4.

Decision Point 3: Is Type of Radiation Known?

This branch assumes that based on initial notification, radiation is suspected on-scene. In the event of a radiological response, it is very useful to know the type of radiation or the specific isotope (which will indicate the type of radiation) involved. This information allows responders to prepare the necessary instruments and equipment needed to characterize a site as well as guide activities once on-scene. At a minimum, a recon kit will be prepared; sampling supplies should also be considered, which can be used to specifically identify the type of radiation on-scene.

***BEST PRACTICE:** Prior to entering the exclusion zone, wrap radiation equipment with expendable materials (e.g. plastic wrap or zip top bags) to prevent instrument contamination.*

- ☐ If the type of radiation is not known prior to mobilization, no additional preparation is required. Proceed to Decision Point 4.
- ☐ If the type of radiation is known prior to mobilization, prepare the following additional equipment and supplies:
 - Sampling equipment appropriate for the incident based on information available. See Table 5 or Appendix C for more information on sampling procedures.
 - A specialized kit based on the type of radiation present. Proceed to the condition associated with the type of radiation present: (a) for alpha, (b) for beta, or (c) for gamma radiation; if a mixture of radiation types is suspected, proceed through all appropriate conditions. (See Table 5 or Appendix B).

Condition A

The branch leading to Condition A indicates alpha radiation is present on-scene; however, be aware other types of radiation may and likely will be present. Of all types of airborne radiation, alpha presents the highest concern; inhalation of alpha-containing particulates has the highest potential for causing disease or death in individuals not wearing respiratory protection. The following additional items may be needed or may assist in site reconnaissance or characterization:

- ☐ The Ludlum 43-90 alpha probe for use with the Ludlum 2241-2;
- ☐ The Ludlum 3030 for analysis of wipe/filter samples;
- ☐ The RAdECo H-810 sampling unit and supplies (sample holder, filter media);
- ☐ Powered Air Purifying Respirator (if PPE requirements are relaxed to Level C or for personnel working outside the exclusion zone);
- ☐ Proceed to Decision Point 4.

Condition B

The branch leading to Condition B indicates that beta radiation is present on-scene; however, again, other types of radiation may be present. Beta-containing particulates are generally only a concern if they accumulate in large quantities on an individual. The following additional items may be needed or may assist in site reconnaissance or characterization:

- ☐ The Thermo RO20 ion chamber capable of detecting beta and gamma;
- ☐ Ludlum 3030 for analysis of wipe/filter samples;
- ☐ The RAdECo H-810 sampling unit and supplies (sample holder, filter media);
- ☐ Proceed to Decision Point 4.

Condition C

The branch leading to Condition C indicates that gamma is expected on-scene. Gamma radiation is a type of radiation whose exposure cannot be mitigated when responders are in the presence of materials emitting gamma; therefore, exposure monitoring is crucial. That said, the majority of radiological detection capability START maintains is geared towards gamma radiation. The following additional instrumentation may be needed or may assist in site reconnaissance or characterization:

- ☐ The Ludlum 133-7 for use with the Ludlum 2241-3;
- ☐ SAM 940/935 gamma spectroscope for isotopic identification;
- ☐ The Thermo RO20 ion chamber capable of detecting beta and gamma;
- ☐ Proceed to Decision Point 4.

Decision Point 4: Is Airborne Contamination Present?

The radiological response condition of the highest concern is when radiological particulate or gases are migrating to air. For the types of radiological response considered under the scope of this SOG, airborne contamination will likely be present only under specific conditions. Whenever an incident involving radiological materials and fire occurs, it must be assumed airborne contamination is being produced; this scenario is most likely to occur during a transportation incident. The only scenario inherently suspected of presenting an airborne threat under the Nuclear/Radiological Incident Annex (see Table 1) within the scope of this document is that of space vehicles entering an uncontrolled descent.

***BEST PRACTICE:** While mobilizing to a site, deploying instrumentation inside the vehicle cab can indicate that airborne radioactive particulates are migrating off-site or alert responders to extremely high radiation levels on-scene. A low-level gamma detector or ion chamber is ideal for this purpose.*

- ☐ If airborne contamination is assumed or known to be present, Level B personal protective equipment (PPE) with self-contained breathing apparatus shall be used in the exclusion zone, and lower stage respiratory protection such as powered air-purifying respirators may be required in work zones outside the exclusion zone. See Table 2a and 2b for setting appropriate distances at a radiological response.
 - Upon arrival on-scene, the Radiation Safety Officer (RSO) should immediately issue dosimetry and inform all site workers of dose limits, alarm limits, and proper actions if any of these levels are reached. The RSO is typically the on-site liaison with the off-site HP. See Table 3 for a list of dose action levels.
 - Prior to entry of the exclusion zone, consult an HP or RSO. See Table 4 for guidance on exclusion zone turnback limits.
 - Enter the exclusion zone to survey the area (see Appendix C for information on exclusion zone surveys), then exit and provide the results to the RSO. The RSO should perform real-time exclusion zone monitoring of responders.
 - Once this data has been reviewed, the entry team can re-enter to more thoroughly characterize the exclusion zone through use of sampling. Proceed to Decision Point 5.
- ☐ If airborne contamination is not present at the site, Level D PPE is appropriate unless the presence of other hazardous materials requires a higher level of protection.
 - Upon arrival on-scene, the Radiation Safety Officer (RSO) should immediately issue dosimetry and inform all site workers of dose limits,

alarm limits, and proper actions if any of these levels are reached. The RSO is typically the on-site liaison with the off-site HP as well as the site Safety Officer (SSO). See Table 3 for a list of dose action levels.

- Perform an operations survey of the work zones to verify that no migration of isotopes has occurred and that radiation levels are below action levels in these areas. See Appendix C for further information on performing radiation surveys.
- Prior to entry of the exclusion zone, consult an HP or RSO to verify no other precautions have been identified that would require a PPE upgrade. See Table 4 for guidance on exclusion zone turnback limits.
- Enter the exclusion zone to survey the area (see Appendix C for information on exclusion zone surveys), then exit and provide the results to the RSO. The RSO should perform real-time exclusion zone monitoring of responders.
- Once this data has been reviewed, the entry team can re-enter to more thoroughly characterize the exclusion zone through use of sampling. Proceed to Decision Point 6.

Decision Point 5: Is Airborne Isotope Migrating Off-site?

The decisions leading to this branch of the decision tree indicate that airborne radioactive contamination, particulates, or gases are being generated and are migrating off site. This is likely the most problematic scenario for radiological response, although it is exceedingly rare within the response scenario covered by this document. In the case of such an event, the primary response actions will be sampling, modeling, and determination of off-site impacts from this data. In the event of contamination migrating off site, the following actions may be performed:

BEST PRACTICE: During a radiological response, the term contamination specifically refers to radioactive particles or gases that are present in air. Therefore, an item is only contaminated with radioactive materials if removable particulate has deposited on it.

- ☐ Request additional support to perform radiation plume monitoring or consult with the OSC to request this information from outside agencies.
- ☐ Locate the plume's source and perform perimeter monitoring of the exclusion zone.
- ☐ Responders would only enter the exclusion zone in this scenario for the purpose of life-saving operations or if a clear means of stopping the release is known. Entry would likely occur under the direction of other groups such as the EPA Radiological Emergency Response Team (RERT) or the Department of Energy (DOE) Radiological Assistance Program Team,

- ☐ If entry is made, proceed through decontamination (See Appendix D).
 - Dry decontamination as described in Decision Point 6 is the preferred decontamination line.
 - Wet decontamination may be necessary for high levels of airborne radioactive contamination.
- ☐ If active airborne migration of radioactive contaminants is ongoing, a decontamination line may be established at a greater distance from the site than common HazMat decontamination lines.

Decision Point 6: Is the Non-airborne Radioactive Isotope Migrating?

The decisions leading to this branch have specifically excluded airborne contamination, which greatly simplifies response actions. The primary mission at this point will be to characterize the exclusion zone and contain the isotopes from potential migration.

- ☐ The primary form of non-airborne radioactive material that can potentially spread is liquid. For response actions that include installation of engineering controls involving liquid forms of radioactive isotopes, it is recommended that responders upgrade PPE to Level C at a minimum to avoid splash hazards to the face. If a liquid source is actively migrating, the following means can be used to stop the migration:
 - Engineering controls, such as berms, trenches, or containment
 - Absorbent pads or some other absorbent material
 - Vacuum trucks
- ☐ This response action will correspond to a self-contained radioactive source (in any physical state) or a source that has been contained from migration as described in the previous bullet item; the following actions should be performed to complete initial response actions:
 - Shield the source in the case of high-radiation fields; this may include erecting barriers around the substance to reduce the radiation levels, placing found materials around the substance if appropriate shielding is not immediately available, or covering with earthen material in extreme cases of very high radiation.
 - Complete all sampling in the exclusion zone of any potentially impacted media, including vegetation, for analysis outside the exclusion zone.
 - Upon exiting the exclusion zone, a dry decontamination corridor will be established. See Appendix D for a graphical representation of the Decontamination Corridor. Responders will first drop samples and instrumentation into two separate yellow-bagged containers; yellow bags are used to segregate and identify radioactive wastes or materials and should be marked in several places with the universal symbol for radiation, a magenta trefoil. After the sample/equipment drop, the decontamination team should perform a decontamination screen; this will be performed by

using either a GM, or, if appropriate, an alpha-specific detector, in the following pattern and at no more than 1 inch from the individual without touching (as each step is passed, remove the associated PPE item):

- Decontaminate outer gloves
 - Decontaminate top of head and protective eyewear or facemask
 - Decontaminate body core (do not remove suit until next step)
 - Decontaminate arms and legs, ensuring not to place the detector under any part of the extremity being screened
 - Decontaminate inner gloves and booties
 - Final spot check of responder without PPE
- If a decontamination screen identifies contamination above action levels, the affected area may be wiped clean or removed with tape if appropriate decontamination materials are unavailable. The option to omit decontamination and proceed to disposal of the PPE as yellow-bagged waste is possible, but this may unnecessarily increase the volume of low-specific activity waste, which, in turn will increase disposal costs.
 - After all personnel have been cleared by decontamination, or if a separate team is available, screening items removed from the exclusion zone should immediately proceed:
 - All samples shall be double-bagged and then screened to ensure that samples being sent for confirmation sampling do not exceed levels prohibited for shipping.
 - Plastic wrapping on instrumentation should be removed and disposed of with accumulated yellow-bagged waste.
 - Screen all equipment and instrumentation with instruments that have not entered the exclusion zone and verify that no surface contamination exists. If an equipment decontamination screen identifies contamination above action levels, wipe affected areas clean or wash with appropriate decontamination solutions. If the screen identifies contamination after attempts at removal, isolate and shield the equipment, and determine disposal method of contaminated items during the recovery phase.

References

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- USDOE Federal Radiological Monitoring and Assessment Center; *Monitoring Manual Volume 2: Radiation Monitoring and Sampling*, Springfield, VA 2005.
- USDOE National Nuclear Security Administration; Radiological Emergency Response Health and Safety Manual, Washington, D.C., 2001.
- USDOE Office of Transportation and Emergency Management; *Model Procedure for First Responder Initial Response to Radiological Transportation Accidents*, Washington, D.C., 2007.
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- USEPA Office of Radiation Programs; *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*, Washington, D.C., 1992.
- USEPA Office of Solid Waste and Emergency Response, Office of Air and Radiation; OSC Radiological Response Guidelines, Washington, D.C., 2006.
- USEPA, USDOE, USNRC, USDoD; *Multi-agency Radiation Survey and Site Investigation Manual (MARSSIM)*, Washington, D.C., 2000.

Radiological Response Resources

Table 1: Types of Radiation Incidents

Coordinating Agencies	
Type of Incident	Coordinating Agency
A. Radiological terrorism incidents (RDD/IND, Radiological Exposure Device): 1. Materials or facilities owned or operated by DoD or DOE 2. Materials or facilities licensed by NRC or Agreement State 3. All others	DoD or DOE NRC DOE*
B. Nuclear facilities: 1. Owned or operated by DoD or DOE 2. Licensed by NRC or Agreement State 3. Not licensed, owned, or operated by a federal agency or an Agreement State, or currently or formerly licensed facilities for which the owner/operator is not financially viable or is otherwise unable to respond.	DoD or DOE NRC EPA
C. Transportation of radioactive materials: 1. Materials shipped by or for DoD or DOE 2. Shipments of NRC or Agreement State licensed materials 3. Shipment of materials in certain areas of the coastal zone that are not licensed or owned by a federal agency or Agreement State 4. All others	DoD or DOE NRC DHS/USCG EPA
D. Space vehicles containing radioactive materials: 1. Managed by NASA or DoD 2. Not managed by DoD or NASA impacting certain areas of the coastal zone 3. All others	NASA or DoD DHS/USCG EPA
E. Foreign, unknown, or unlicensed material: 1. Incidents involving foreign or unknown sources of radioactive material in certain areas of the coastal zone. 2. All others.	DHS/USCG EPA
F. Nuclear weapon accident/incident (based on custody at time of event)	DoD or DOE
Other types of incidents not otherwise addressed above	DHS designates
* For category A(3), "all other" radiological terrorist incidents, DOE is designated as the Coordinating Agency in the table. F or this category of incident, however, the annex states that the Coordinating Agency role transitions from DOE to EPA for environmental cleanup and site restoration at a mutually agreeable time, and after consultation with state, local, and tribal governments, the cooperating agencies, and the JFO Coordination Group.	

DHS Department of Homeland Security
DoD Department of Defense
DOE Department of Energy
EPA Environmental Protection Agency
IND Improvised Nuclear Device
NASA National Space and Aeronautics Administration
NRC Nuclear Regulatory Commission
RDD Radiological Dispersion Device
USCG United States Coast Guard

Source: OSC Radiological Response Guidelines (2006)

Tables 2a - b: Radiological Incident Work Zones

Table 2a: Initial Exclusion Zone Guidance	
Source	Radius
Unshielded or damaged (outside)	30-meter radius
Major spill (outside)	100-meter radius
Fire, explosion, or fumes involved (outside)	300-meter radius
Suspected bomb, exploded or unexploded (outside)	400-meter radius, or the distance needed to protect against an explosion
Shielding damaged or lost, or source spilled (inside)	Affected and adjacent areas (including floors above and below)
Fire or other contamination-spreading event (inside)	Entire building plus distance needed to meet guidelines for outdoors incidents (above)

Source: IAEA Manual for First Responders to a Radiological Emergency (2006)

Table 2b: Zones of Operation	
Action Level	Zone
Background (Typically 10–15µR/hr; but at least less than 100 µR/hr)	Support Zone
Twice Background	Contamination Reduction Zone
≥ 2 mR/hr	Exclusion Zone

µR/hr microrentgens per hour
mR/hr milliroentgens per hour

Table 3: Radiation Dose Action Levels

Radiation Response Levels		
Radiation Level	Action	Reference
< 1 mR/hr above background	Continue monitoring, contact health physicist	EPA Standard Operating Safety Guides
> 1 mR/hr above background	Withdraw. Continue monitoring only on HP advice	EPA Standard Operating Safety Guides Default alarm level for EPDs
2 mR/hr	NRC criterion for radiation area. Below this, OSHA annual limit not exceeded for work year of 2,000 hours	10 CFR 20
50 mrem/quarter	TLD report Action Reference Level for investigation	EPA Safety Health & Environmental Management Guide 38 default alarm level for EPDs
500 mrem/year	EPA Administrative Control Level. Waiver required to exceed	EPA Safety Health & Environmental Management Guide 38
5000 mrem/year	EPA/OSHA annual limit	EPA Safety Health & Environmental Management Guide 38
1.5 R/hr	EPA "stop and check" level. Dose management encouraged	Guidance for EPA Personnel Responding to Radiological Emergencies
10 R/hr	EPA "stop and check" level. For lifesaving or critical actions	Guidance for EPA Personnel Responding to Radiological Emergencies , NCRP 138
5 rem	EPA Emergency Worker Dose Guidance general limit	EPA Manual of Protective Action Guides
10 rem	EPA Emergency Worker Dose Guidance limit for protecting valuable property	EPA Manual of Protective Action Guides
25 rem	EPA Emergency Worker Dose Guidance limit for lifesaving or protection of large populations. Exceeding this value permitted on a voluntary and informed basis only, written management waiver required	EPA Manual of Protective Action Guides

CFR Code of Federal Regulations
EPA U.S. Environmental Protection Agency
EPD Electronic Personal Dosimeter
HP Health Physicist
mR/hr milliroentgens per hour
mrem millirem
NCRP National Council on Radiation Protection
NRC Nuclear Regulatory Commission
OSHA Occupational Safety and Health Administration
R/hr roentgen per hour
TLD Thermoluminescent Dosimeter

Tables 4a - c: Radiation Turnback Levels by Type of Radiation

Table 4a: Emergency Conditions Involving Alpha and Beta Radiation*			
Alpha on the ground turnback level		Beta on ground turnback level	
≥ 2,000 dpm/100cm2 ≈ 400 cpm with Ludlum model 2241-2 (or comparable) coupled with alpha probe model 43-90}		≥ 10,000 dpm/100cm2 ≈ 400 cpm with Ludlum model 2241-2 (or comparable) coupled with pancake probe model 44-9}	
Leave the area until you have protective clothing and respiratory protection—evaluate actions against dose limits		Leave the area until you have protective clothing and respiratory protection—evaluate actions against dose limits	
* These values assume a static measurement on the ground (or a flat surface) at a distance of 1 cm; alpha-only or beta-only instruments may respond erroneously in a high gamma rate field			
cm	centimeter	cpm	counts per minute
cm2	square centimeter	dpm	disintegrations per minute

Table 4b: Emergency Conditions Involving Gamma Radiation			
Time Period	Employee Type	Turnback Level	Condition
Early Phase (Release On-going)	OSCs, initial EPA Responders	10 R/hr	Voluntary, with supervisor review, for lifesaving or critical actions ONLY- evaluate anticipated doses against dose limits in EPA Guidelines for Control of Emergency Exposure (above)
Early Phase (Release terminated)	OSCs, RERT-Forward, ERT, and initial EPA Responders		Dose management imperative
Intermediate Phase (some data available)	OSCs, RERT-Forward, ERT	1.5 R/hr	Remedial phase limit or during airborne plume survey missions
Late Phase (cleanup)	Any EPA employee, RERT-Support and Home Teams	Site Specific according to HASP	EPA Action Reference Level: 50 mrem/quarter and Administrative Control level 500 mrem/year
EPA	U.S. Environmental Protection Agency	OSC	On-Scene Coordinator
ERT	Emergency Response Team	R/hr	roentgens per hour
HASP	Health and Safety Plan	RERT	Radiological Emergency Response Team
mrem	millirem		

Table 4c: Notification Guidelines for Arrival	
Instrument	Limit
Micro R Meter	100 uR/hr
Pancake GM Detector	330 cpm
uR/hr	microroentgens per hour
	cpm
	counts per minute

Table 5: Instrumentation and Sampling Kits

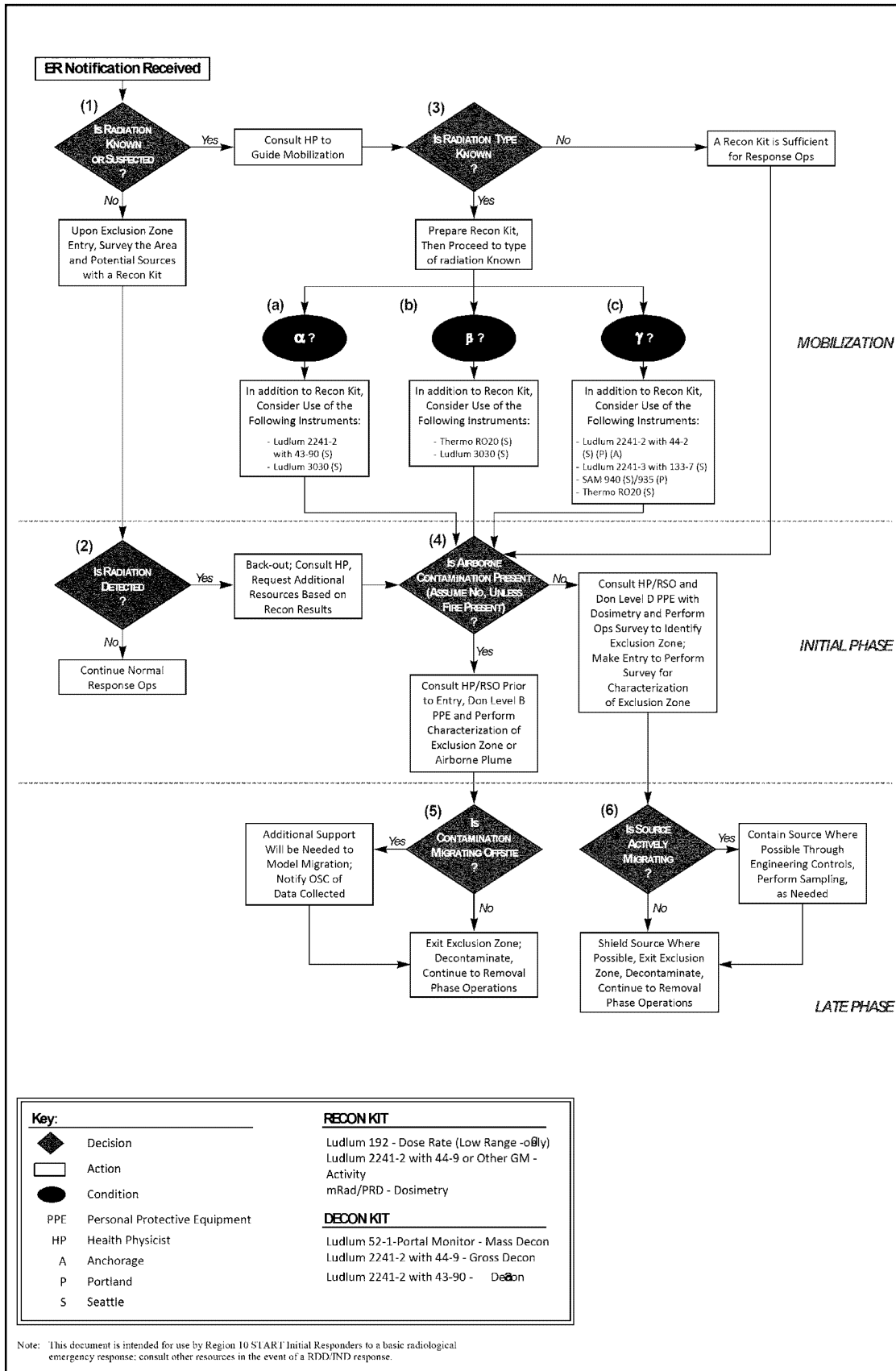
Radiation Instrument Selection			
Activity	Considerations	Instrument Type	Equipment
Initial Entry	<ul style="list-style-type: none"> • Presence of radiation is known • Primary task is to save lives or do a quick assessment • Entry team exposure control is primary concern (use of time, distance, shielding) • Decontamination may be necessary 	Real time dosimeter (dose)	EPD MK2 mRAD 103 RadEye PRD
		Alpha, beta, gamma detector	Ludlum 2241-2 w/44-9 probe Radeye B20
		Gamma detector (exposure rate)	Eberline RO20 (w/ beta screening capability) 2241-3 w/ 133-7 probe MicroR Meter (saturation at 5 milliroentgens per hour)
		Alpha detector	2241-2 w/ 43-90
Routine/Survey	<ul style="list-style-type: none"> • Unknown or suspected contaminant • Primary task is identification and characterization • Utilize time, distance, shielding to minimize exposure 	Real time dosimeter (dose)	EPD MK2 mRAD 103 RadEye PRD
		Beta detector (contamination survey)	Ludlum 2241-3 w/ 44-9 probe
		Gamma detector (exposure rate/source survey)	MicroR Meter Ludlum 2241-2 w/ 44-10 probe
Specialty	<ul style="list-style-type: none"> • Type of radiation will require specialized instrumentation • Purpose of instrument selection: Field Analysis, Identification, Neutron, Mass Decontamination 	Gamma detector (high exposure rate)	Ludlum 2241-3 w/133-7 probe
		Alpha, beta counting (sample analysis)	Ludlum 3030
		Gamma spectroscopy (sample analysis/ID)	Sam 940/935
		Neutron detector	Ludlum 15 Eberline RO20 (extremely low sensitivity)
		Mass decontamination	Ludlum 2241 w/ 44-9 probe Ludlum 52-1 Portal Monitor
Sampling	<ul style="list-style-type: none"> • Sampling of environmental media require protocols different than routine sampling • Sampling equipment is not dependent on type of radiation 	Air	RADeCO H810 Hi-Vol Sampler
		Surface	4"x4" Wipe
		Soil/Vegetation	Trowel Shovel Scoop

Tables 6a - b: Technical Data and Definitions

Table 6a: Definitions	Standard Units	SI Units
Radioactivity	Curie (Ci)	Bequerel (Bq)
Absorbed Dose	Rad	Gray (Gy)
Dose Equivalent	Rem	Sievert (Sv)
Exposure	Roentgen (R)	Coulomb/kilogram (C/kg)
For gamma & x-ray: 1 R \approx 1 rad \approx 1 rem		

Table 6b: Conversions			
Unit		Value	Conversion
1 becquerel (Bq)	=	1	disintegration per second (dps)
1 terabecquerel (TBq)	\sim	27	curie (Ci)
1 gigabecquerel (GBq)	\sim	27	millicurie (mCi)
1 megabecquerel (MBq)	\sim	27	microcurie (μ Ci)
1 kilobecquerel (kBq)	\sim	27	nanocurie (nCi)
1 becquerel (Bq)	\sim	27	picocurie (pCi)
1 curie (Ci)	\sim	37	gigabecquerel (GBq)
1 millicurie (mCi)	\sim	37	megabecquerel (MBq)
1 microcurie	\sim	37	kilobecquerel (kBq)
1 nanocurie (nCi)	\sim	37	becquerel (Bq)
1 picocurie (pCi)	\sim	37	millibecquerel (mBq)
1 Gray (Gy)	=	100	rad (rad)
1 milligray (mGy)	=	100	millirad (mrad)
1 microgray (μ Gy)	=	100	microrad (μ rad)
1 nanogray (nGy)	=	100	nanorad (nrad)
1 kilorad (krad)	=	10	gray (Gy)
1 rad (rad)	=	10	milligray (mGy)
1 millirad (mrad)	=	10	microgray (μ Gy)
1 microrad (μ rad)	=	10	nanogray (nGy)
1 sievert (Sv)	=	100	rem (rem)
1 millisievert (mSv)	=	100	millirem (mrem)
1 microsievert (μ Sv)	=	100	microrem (μ rem)
1 kilorem (krem)	=	10	sievert (Sv)
1 rem (rem)	=	10	millisievert (mSv)
1 millirem (mrem)	=	10	microsievert (μ Sv)
1 microrem (μ rem)	=	10	nanosievert (nSv)

U.S. EPA REGION 10 RADIOLOGICAL EMERGENCY RESPONSE DECISION TREE





EPA Radiological Emergency Response



Gamma Exposure Rate Turnback Levels

Early Phase (release ongoing): 10 R/hr
Intermediate Phase (some data available): 1.5 R/hr

If exposure rate > turnback level, obtain guidance and follow allowed conditions in order to proceed

Alpha/Beta Contamination Turnback Levels

Alpha: $\geq 2,000$ dpm/100 cm² on the ground
(≈ 400 cpm National Buy instrument)
Beta: $\geq 10,000$ dpm/100 cm² on the ground
(≈ 400 cpm National Buy instrument)

When turnback level is reached, leave area to obtain protective clothing and respiratory protection; evaluate actions against dose limits

Protective clothing should be worn if alpha or beta contamination > natural background

Respiratory protection should be worn if loose alpha or beta contamination > natural background

Notification Guidelines for Arrival (Ambient Reading)

Micro R meter: 100 μ R/hr
Pancake GM detector: 330 cpm

If guidelines are exceeded, notify EPA, RERT, and state/local response programs

EPA Radiation Dose Limits (TEDE)

Non-emergency response
(EPA admin control level, ACL): 500 mrem/yr
Radiation emergency response: 5,000 mrem (5 rem)

Exceeding the ACL requires concurrence of senior EPA official on-site, Incident Commander, Health & Safety Officer, or Radiation Safety Officer

See OQC Radiological Response Guidelines for other dose limits

Early and Intermediate Phase Stay-Times (Gamma Exposure Rate)

Exposure Rate	Up to 5 rem TEDE limit for emergency operations
0.1 R/hr	50 hours
1 R/hr	5 hours
5 R/hr	1 hour
10 R/hr	30 min
25 R/hr	12 min
50 R/hr	6 min
100 R/hr	3 min

Exposure rates in shaded areas exceed guidance levels and require supervisory review

Helpful Conversions

1,000 μ R/hr = 1 mR/hr
1,000 mR/hr = 1 R/hr
1 Sv = 100 rem
1 Gy = 100 rad
1 Ci = 37 GBq
For gamma and x-rays: 1 R \approx 1 rad \approx 1 rem

Labs

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Richard Graham (303) 312-7080

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Donna Kassel (716) 684-2530

Resources

RAD PRO CALCULATOR
www.radprocalculator.com

**RAD EMERGENCY MEDICAL
MANAGEMENT**
www.remm.nlm.gov

EPA Turnback Guidelines for Control of Emergency Exposure

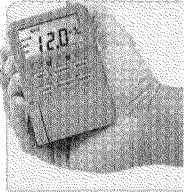
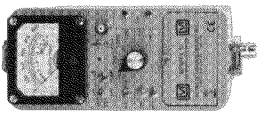
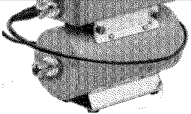

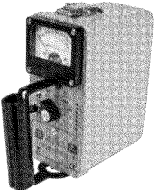
Dose Limit	Activity	Condition
5 rem	All	None
10 rem	Protecting valuable property	Voluntary; Lower dose not practicable
25 rem	Lifesaving or protection of large populations	Voluntary; lower dose not practicable
>25 rem	Lifesaving or protection of large populations	Only on a voluntary Basis to persons fully aware of the risks involved

Source: Manual of Protective Action Guides and Protective Actions for Nuclear Incidents (1992 EPA 400-R-92-001)

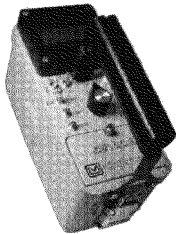
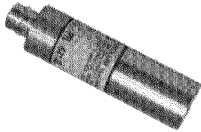
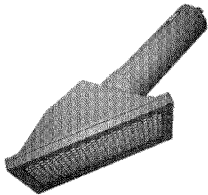

Primary Use	Survey/Site	Survey/Exclusion	Contamination monitoring or source location	Contamination monitoring or source location	Contamination monitoring	Screening & Isotope Identification	Nuclear Events	Alert Monitor	Dosimetry	Dosimetry
Make/Model	Ludlum 192	Eberline RO20	Ludlum 2241	RADEYE B20	Ludlum 3030	SAM 940	Ludlum 15	RAD4/50	RADEYE PRD	MRAD 103
Detection Range	0 - 5000 μ R/hr	0 mR/hr - 50,000 mR/hr or 0-5, 0-50, 0-500 mR/h and 0-5, 0-50 R/h (Effective Range >5 mR/hr)	0.0 microR/hr - 9999 R/hr; 0.000 μ Sv/hr - 9999 Sv/hr; 0 cpm - 999k cpm; or 0 cps - 100k cps	0 - 10 kcps, 0 - 200 mRem/hr, 2 mSv/hr	0 - 999999 cpm or dpm	0 μ rem/hr - 500 rem/hr	0-500,000 cpm	0 μ R/hr - 50 mR/hr, 0 - 50,000 cpm	0 μ Rem/hr - 25 mRem/hr, 0 μ Sv/hr - 250 mSv/hr, cps dependent on isotope decay energies	1.0 μ R/hr to 500R/hr (dose rate); 0.1 μ R to 999R (total dose).
Can Detect	Y	β , γ .	α , β , γ	α , β , γ	α , β	Y	β , γ , n	α , β , γ	β , γ	β , γ

DECAY TYPE	Radiological Agent & Symbol									
α , Low level γ	Americium 241 Am 241	X	X	X	X	X	X	X	X	X
β , γ	Cesium 137 Cs 137	X	X	X	X	X	X	X	X	X
β , γ	Cobalt 60 Co 60	X	X	X	X	X	X	X	X	X
β , γ	Iodine 131 I 131	X	X	X	X	X	X	X	X	X
β , γ	Iridium 192 Ir 192	X	X	X	X	X	X	X	X	X
α , Low level γ	Plutonium 238, 239, 240, Pu 238, 239, 240			X	X	X		X		
α , Low level γ	Polonium 210 Po 210			X	X	X		X		
β	Strontium 90 Sr 90		X	X	X	X	X	X	X	
α , Low level γ	Uranium 235, 238 U 235, 238	X	X	X	X	X	X	X	X	X

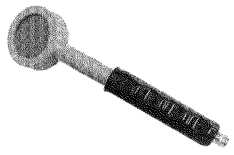
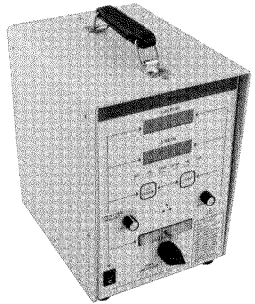
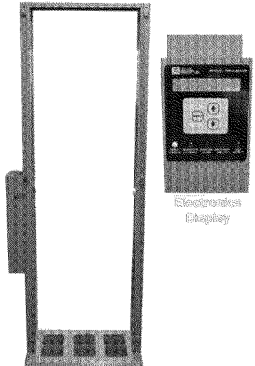
Appendix B: Instrument and Equipment Catalog

Appearance	Manufacturer/Model (common name)		Type of Detector	Type(s) of Radiation	Effective Range(s)	Intended Use
	Canberra UltraRadiac 103 (mRad)		Geiger-Mueller (GM)	Beta (High-energy) Gamma	0 µR/hr - 200 R/hr (Dose Rate) 0.0 µR - 999 R (Dose) (Auto-scales all units)	Entry Team Dosimeter
	Ludlum 15		None	Alpha Beta Gamma	0 cpm - 500 cpm 0 cpm - 5,000 cpm 0 cpm - 50,000 cpm 0 cpm - 500,000 cpm	Nuclear Incident Meter
	Ludlum 15 Neutron Detector		Gas Proportional	Neutron	Thermal Neutrons up to 12MeV	Nuclear Incident Detector
	Ludlum 44-7		Geiger-Mueller (GM)	Alpha (low-sensitivity) Beta Gamma	Not Applicable	Surface Contamination Screening
	Ludlum 192 (MicroR)		Gamma Scintillator (Sodium Iodide)	Gamma	0 µR/hr - 5 µR/hr 0 µR/hr - 50 µR/hr 0 µR/hr - 500 µR/hr 0 µR/hr - 5,000 µR/hr	Operational Survey Meter (Gamma)

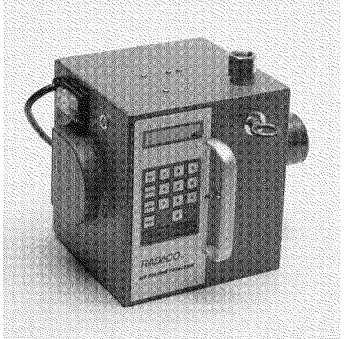


Appendix B: Instrument and Equipment Catalog

Appearance	Manufacturer/Model (common name)		Type of Detector	Type(s) of Radiation	Effective Range(s)	Intended Use
	Ludlum 2241-2/3		None	Not Applicable	0.0 μ R/hr - 9999 R/hr 0 cpm - 999 kcpm 0 cps - 100 kcps (Auto-scales all units)	Multi-purpose Meter
		Ludlum 133-7 (Peanut)	Geiger-Mueller (GM)	Gamma	25 mR/hr - 100 R/hr	Entry Team Gamma Survey Detector (High-Radiation Field)
		Ludlum 43-90	Alpha Scintillator (Zinc Sulfide)	Alpha	Not Applicable	Alpha Entry Team Screening, Alpha Decontamination Screening
		Ludlum 44-2	Gamma Scintillator (Sodium Iodide)	Gamma	0 μ R/hr - 25 mR/hr	Operational Gamma, Survey Detector

Appendix B: Instrument and Equipment Catalog


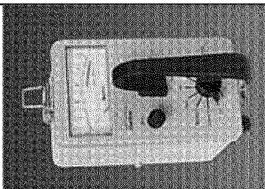
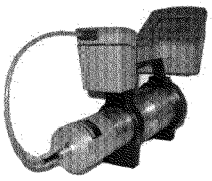
Appearance	Manufacturer/Model (common name)		Type of Detector	Type(s) of Radiation	Effective Range(s)	Intended Use
		Ludlum 44-9 (Pancake)	Geiger-Mueller (GM)	Alpha (low-sensitivity) Beta Gamma	0 cpm - 100 kcpm	Multi-purpose Detector
	Ludlum 3030		Alpha/Beta Scintillator (Zinc Sulfide on Plastic)	Alpha Beta	0 counts - 999,999 counts	Wipe/Solid Sample Analysis (w/o Definitive Data)
	Ludlum 52-1 (Portal Monitor)		Beta/Gamma Scintillator x4 (Plastic)	Beta Gamma	0.0 - 6.9 deviations above background	Mass Decontamination

Appendix B: Instrument and Equipment Catalog

Appearance	Manufacturer/Model (common name)	Type of Detector	Type(s) of Radiation	Effective Range(s)	Intended Use
	RADeCO H-810	None	Not Applicable	None	Air Sampler
	S.E. Intl Radiation Alert Monitor 4	Geiger-Mueller (GM)	Alpha (low-sensitivity) Beta Gamma	0 mR/hr - 0.5 mR/hr 0 mR/hr - 5 mR/hr 0 mR/hr - 50 mR/hr 0 cpm - 500 cpm 0 cpm - 5000 cpm 0 cpm - 50,000 cpm	Operational Survey Meter
	Thermo RadEye B20	Geiger-Mueller (GM)	Beta (High-energy) Gamma	0 µrem/hr - 200 mrem/hr 0 cps - 10 kcps (Auto-scales all units)	Decontamination Screening, Operational Survey Meter

US EPA Region 10 Radiological Incident Response SOG
EPA Region 10 Instrument and Equipment Catalog

Appendix B: Instrument and Equipment Catalog

Appearance	Manufacturer/Model (common name)	Type of Detector	Type(s) of Radiation	Effective Range(s)	Intended Use
	Thermo RadEye PRD	Gamma Scintillator (Sodium Iodide)	Gamma	1 µR/h - 25mR/h (Auto-scaling) Limit of Response = 1000 R/h	Dosimeter
	Thermo RO20	Ion Chamber	Beta Gamma Neutron (low-sensitivity)	0 mR/hr - 5 mR/hr 0 mR/hr - 50 mR/hr 0 mR/hr - 500 mR/hr 0 R/hr - 5 R/hr 0 R/hr - 50 R/hr	Entry Team Survey Meter (High-Radiation Field)
	Berkley Nucleonics SAM 940	Gamma Spectroscopy (Sodium Iodide/ Lithium-6 Iodide)	Gamma	0 µR/hr - 100 R/hr 0 cps - 999 kcps	Isotopic Identification, Sample Analysis (w/o Definitive Data)

µR/hr microroentgens per hour
 cpm counts per minute
 kcpm kilocounts per minute
 kcps kilocounts per second
 MeV mega electron Volts
 mR/hr milliroentgens per hour
 mrem/hr millirems per hour
 R roentgen
 R/hr roentgens per hour

Appendix C: Field Survey and Sampling Guidelines

Overview: Radiological incident response includes tasks that are not common to basic hazardous material incidents such as field surveys. Field surveys are intended to provide baseline data for potential radiological exposure to personnel in a certain area. They are also used to identify the potential spread of contamination. This section provides information for performing field surveys and may be incorporated into decision-making activities during a response. The EPA Regional Emergency Response Team maintains specific guidance on performing different types of surveys in the 400 series of the Radiological Standard Operating Procedures.

Sampling activities are generally the same as other types of hazardous materials response; however, specialized analysis techniques are required to provide results. Some field analytical capabilities are possible to determine activity, but isotopic identification is only possible for isotopes producing gamma radiation; off-site analyses would be needed for other types of radiation. The Department of Energy Federal Radiological Monitoring and Assessment Center maintains detailed sampling procedures and best practices for sampling events.

Background Surveys

Before any operational survey can proceed, a background survey is required to provide a minimum threshold for comparison purposes. It is preferable to have background data for the site location, but this information is typically unavailable during an emergency response. Therefore, background values for an emergency response should consist of at least three measurements at a representative location within the same general area of the site. One of the three readings can be read from the vehicle as responders approach the site; responders typically carry a gamma instrument during site approach to determine if any radiological plumes are migrating off site. The other two values should be taken well outside the exclusion zone but within a mile of the site and should consist of environmental conditions similar to the source (e.g., urban, rural, geological, indoor).

Each background measurement (other than the reading taken upon approach of the site) should be taken at both waist height, or approximately 3 feet above level surface, and at approximately 6 inches from level surface, recording the results with each associated height. So, for the two stationary background readings, four total values will be recorded.

Operational Surveys

An operational survey is the most common type of survey performed at any type of event where radiological materials are present. Operational surveys are used to define baseline values of dose rate in common work areas, as well as to identify potential sources of contamination. The procedure is performed with, at a minimum, a gamma or beta/gamma dose rate-capable meter and a screening meter such as a

Geiger-Mueller (GM) detector, or some other specialized detector if a specific type of radiation is expected.

In the context of radiological incident response, operational surveys will be performed in two distinct categories: routine operational surveys and exclusion zone surveys. The routine operational survey is performed at specific intervals, or as close to them as reasonably possible. The exclusion zone survey will only be performed when an entry into an exclusion zone is absolutely necessary and either prior to or in conjunction with the entry of the leading survey team. Only in situations of life-saving conditions should the entry team perform an exclusion zone survey while simultaneously performing other expected exclusion zone tasks. However, in situations where limited personnel are available, the entry team members can perform the exclusion zone survey provided they exit the exclusion zone upon obtaining results and prior to initiating tasks in the exclusion zone other than the survey.

Routine Operational Surveys

Upon arrival at a radiological incident, the first action taken on-scene should be to establish safe work zones and other activities associated with site setup. The operational survey is intended to assist in this by determining levels of radiation present in areas outside the exclusion zone. In conjunction with Incident Command, who will establish work zones and plan the course of the response, survey teams should provide the results of their surveys to aid this process. Typically, survey teams will document these actions by using a form mapping all accessible areas of a site and noting readings at random point locations within that boundary.

The survey should be scheduled to occur at least twice during any work shift but may be increased as feasible based on personnel availability. From these results, signage should be posted noting the potential for radiation to be present in these areas. Action levels should also be prepared to screen unacceptable levels in a work zone, as well as procedures to address the findings, such as monitoring, decontamination, or if necessary, movement of work zones.

Exclusion Zone Surveys

The first action taken in an exclusion zone established for response purposes should be a survey of areas the entry team is expected to access; however, the survey should be limited to these areas only. It is expected that high radiation levels will be encountered, and so the survey should be performed rapidly to decrease exposure to the survey team. An exclusion zone survey should be considered valid for the specific entry associated with the survey; therefore, for each entry into an exclusion zone with known radiological isotopes present, an exclusion zone survey shall be performed.

Results of the exclusion zone survey shall be reviewed by the Radiation Safety Officer (RSO) prior to entry. Based on the information obtained by the survey, the RSO or a Health Physicist (HP) may either restrict certain actions of the entry team or make recommendations to Incident Command for additional tasks in the exclusion zone to mitigate exposure for later entries.

Sampling and Analysis

The types of media that are commonly sampled for radioactivity are air, surfaces, and vegetation or soil surface. Water can be sampled for radioactivity but the procedures for doing so are the same as common water sampling techniques, with the exception that contamination of sampling accessories may occur, requiring a special waste stream. This section provides a description of sampling techniques, the accessories or equipment required, and the rationale for sampling for each medium.

Air

Sampling air for radioactivity is generally performed so an HP or RSO can determine what kinds of respiratory protection must be deployed at a site. There are two conditions for sampling for air: airborne radioactive particulates or airborne radioactive gases.

Airborne radioactive gases generally will only be present during a nuclear incident, and therefore outside the scope of this document. If a scenario occurs involving sampling for radioactive gases, basic air sampling techniques are performed using tedlar bags or summa canisters. It is possible that air sampling pumps or canisters will be contaminated by this process, which means that equipment may need to be scrapped or idled until several half-lives have occurred.

It is possible to sample air containing radioactive particulates using the RADeCO H-810. This item displaces a volume of air over a period of time as set by the sampler. Typically, the values are chosen to replicate the volume of air a worker will displace in a given work shift. The sampling unit should be positioned in the breathing zone. Also, the sampling apparatus which consists of a filter and filter holder should be protected from airborne contaminants until the moment the sample is taken. Once the sampler has displaced the total amount of air, the sample should be placed in a labeled glassine envelope, placed in a plastic bag and labeled.

One advantage of the RADeCO air sampler is that screening of samples can occur in the field using either the Ludlum 3030 or a common GM detector, although the GM detector will not have a high sensitivity for alpha radiation, so an alpha scintillator should be used for specific analysis.

Surface

Sampling surfaces for radioactivity is generally performed during an operational survey or exclusion zone entry to determine the presence of surface contamination. Typically the surface contamination is particulate matter; however, isotopes in liquid phases can also be absorbed by the sampling media. In the case of sampling of liquid phase isotopes, field analysis is not possible since the media can act as shielding to gross radiation. Surface sampling can also be performed as a quality control check for decontamination lines.

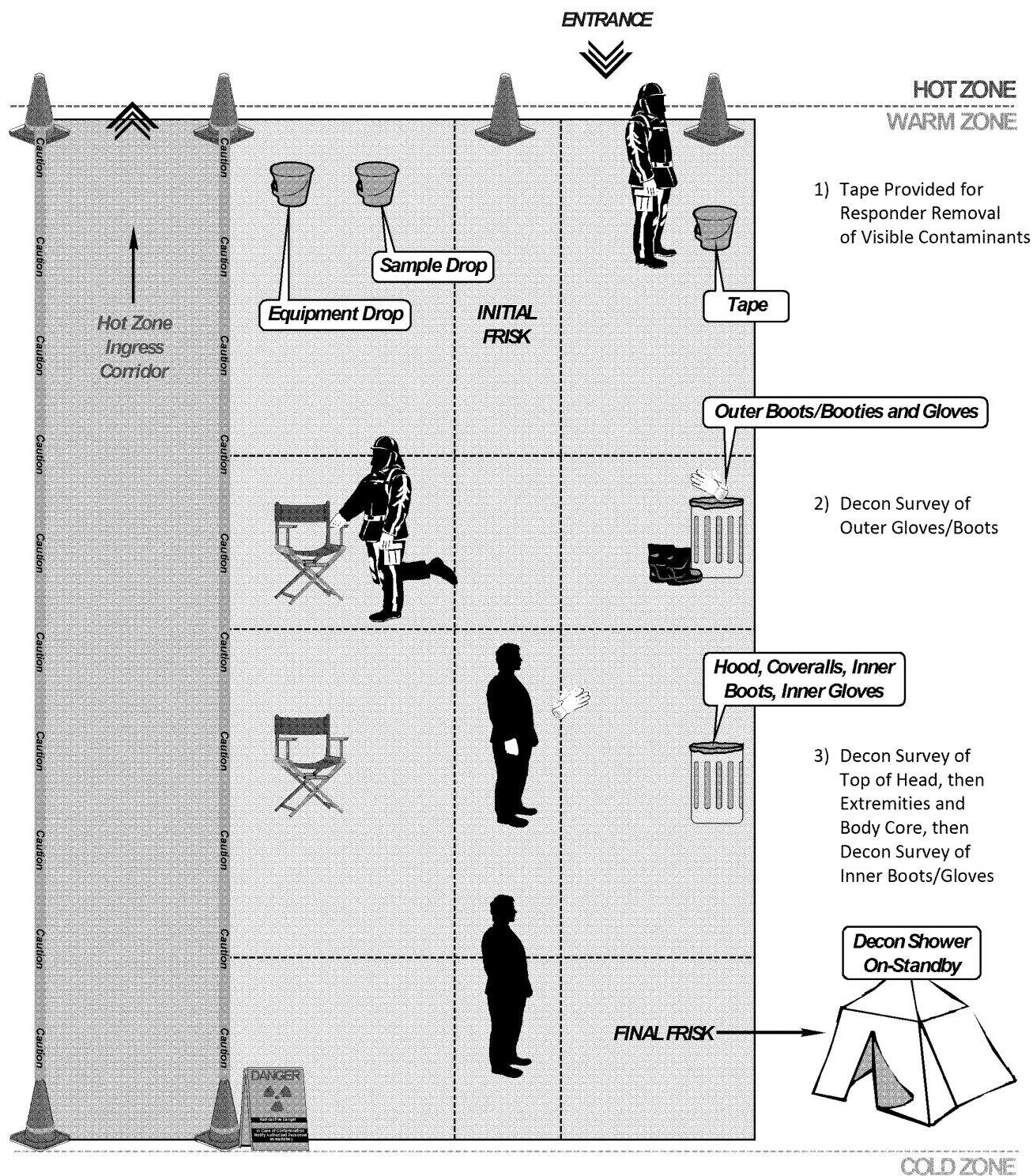
Surface sampling is performed by taking a 1 inch x 1 inch wipe and covering a 100-square-inch area. If the area to be sampled is less than 100 square inches, a length of approximately 1 foot should be wiped. As with air sampling, the swipe should be placed in a labeled glassine envelope, bagged, and labeled. Also, as with particulate samples, the swipes can be screened in the field with the same instrumentation.

Vegetation/Soil Surface

This type of sampling is advantageous since, like surface sampling, it can be used for isotopes in both the solid and liquid phase. The disadvantage of sampling of soil or vegetation is that field analysis is not possible and must be sent out to a specialized laboratory. The need to sample vegetation or soil will occur if isotopes migrate (either by airborne deposition or liquid phase absorption) to an area where instrument screening may not provide complete characterization due to shielding by the media.

Soil sampling for radioactive isotopes is different from common soil sampling techniques in that only the surface of the soil is needed for the analysis. Generally, the top 3 inches of soil is all that is needed for soil surface sampling because soil from the subsurface is unlikely to have significant concentrations of radioactive isotopes and may “dilute” the results of the analysis. Therefore, a trowel or scoop is all that is needed to collect the soil sample which may be placed in either plastic bags or common soil sampling jars.

Vegetation sampling is a simple process utilizing items such as clippers or trowels to remove the vegetation (but avoiding collection of large amounts of soil). The vegetation should be bagged in a labeled plastic bag. Volumes of vegetation can vary based on the type of analysis needed, but since the relative concentration of potential radiation to vegetation is very low, a good rule of thumb is to collect a gallon bag of the material.



Appendix D-1
Radiation Decontamination

Appendix E: Revision History

Date	Version	Page(s)	Change/Revision	Rationale
3/26/14	2.0	All	Document-wide revision to Final version	Improved coherency and ease of use

RPP Monthly Call Agenda
December 20, 2016
12:00pm Eastern (Washington, DC Time)
EPA WJC West Building, Conference Room 1424

Call in Number [REDACTED]
Access Code [REDACTED]

12:00pm – 12:15pm	Welcome/Roll Call, New Staff Intro – Rafie/Sara
12:15pm – 12:30pm	PAGs Outreach Webinars Plan – Sara and Sam Hernandez, OW
12:30pm – 12:45pm	Region 10 OSC Project Discussion – John Cardarelli, OLEM/OEM and Dennis Carney, Dynamac
12:45pm – 1:00pm	Radiation Training Discussion – George, R6 & Rafie

HAPPY HOLIDAYS!

Upcoming Events

To: Steuteville, William[Steuteville.William@epa.gov]
Cc: Cardarelli, John[Cardarelli.John@epa.gov]; Borries, Samuel[borries.samuel@epa.gov]; El-Zein, Jason[el-zein.jason@epa.gov]
From: Jablonowski, Eugene
Sent: Wed 10/26/2016 9:31:21 PM
Subject: Re: Thank You and Northern Lights Comments

Hi Bill, and John,

A more comprehensive write-up will be coming from me soon but I just wanted to say for now thank you very much for your participation in the exercise. I believe you two exceeded Minnesota's expectations for support during the exercise from the conversations I had with HSEM, MPCA, and MNDOT; you guys along with NHSRC made us look great, especially with I-94 decon, waste management, and water. I don't think FRMAC did as well in the eyes of the state given the MN's issues in getting FRMAC products, FRMAC's questioning of the MN's needs during the exercise, and remarks made by MN ("I need what I ask for since I have to report to my governor with options or I'll get fired...").

In short I concur with the need to de-conflict the PAGs, as well as better defining the occupational safety legal requirements for both response/recovery workers and non-response workers. If this were real, I don't think the FRMAC would be able explain why its ok to return people to live 2 miles from the plant when the state may be embargoing food 50+ miles away from the plant, and their conservative assumptions like the baby that eats 2.5-lbs of contaminated beef/day won't help their credibility. John and I have discussed this and plan on making this a point to work on with the Advisory Team and the FRMAC dose assessors, with an Advisory Team meeting coming up in early December.

I also agree with the need for a EPA Rad CONOP or response/recovery plan. During the controllers meeting following the hotwash, it was recognized that we need to plan these exercises better (this one was acknowledged to be rushed and badly planned), develop a calendar and objectives up to 5 to 10 years out like FEMA, building upon what we learn , and use what we learn in existing plans or develop new plans.

Quickly answering your questions:

1. The meat and dairy (ag and food overall) protective action guidelines (PAGs) for individual food items like meat and dairy are "projected dose commitment values to individuals in the general population that warrant protective action following a release of radioactive material." They are based on 0.5 rem for committed effective dose equivalent or 5 rem committed dose equivalent to an individual tissue or organ, whichever is more limiting. Exposure assumptions will vary since "fraction of the food intake assumed to be contaminated" and the "quantity of food consumed in an appropriate period of time" will vary (say pounds of meat vs corn eaten by someone).
2. The modeling is done as a first projection of where the contamination may go and where to assign and prioritize efforts for monitoring and assessment. The appropriate state/local agencies may apply initial embargoes within a day of the incident based on the projections, before any monitoring data is available. Lab analysis takes time but I think between aerial assets like ASPECT and modern rad equipment on the ground, we could get these areas roughly screened within a couple of days. If you recall, I covered the Liberty RadEx plume area all by myself with CMAD's ground equipment in about 10-hours of driving. FRMAC or EPA could perform the initial screening of the impacted areas, but its USDA and FDA that should be stepping up on the food and ag issues, IMHO.

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From: "Steuteville, William" <Steuteville.William@epa.gov>

Date: Wednesday, October 26, 2016 at 2:34 PM

To: Eugene Jablonowski <jablonowski.eugene@epa.gov>, Sara DeCair <DeCair.Sara@epa.gov>, Kathryn Klawiter <Snead.Kathryn@epa.gov>, John Cardarelli <Cardarelli.John@epa.gov>, "Hallam, Christopher" <Hallam.Christopher@epa.gov>

Cc: Lee Veal <Veal.Lee@epa.gov>, "Gross, Bonnie" <Gross.bonnie@epa.gov>, Samuel Borries <Burries.Samuel@epa.gov>, "Aquino, Marcos" <Aquino.Marcos@epa.gov>

Subject: Thank You and Northern Lights Comments

This is an Exercise. This is an Exercise.

Hi all!

I wanted to tell you how much I appreciated participating in Northern Lights 2016. I learned a great deal and enjoyed it more than other exercises. I enjoyed working with you. I am proud of the coordination and cooperation of all the EPA players representing R5 (me?!?), ORIA RERT including the labs, A Team, and PIO, and OLEM CMAD, as well as folks from NHSRC (and others from OEM and ORCR) who dropped everything to consult remotely and provide products to support the EPA players and the exercise. They made us look good! It was a very successful collaboration. If I missed any EPA programs that supported Northern Lights, I apologize. Northern Lights 2016 was far and away the most successful demonstration I have seen of the FRMAC and Advisory Team as assets to support "state" decision making. It also got to issues beyond evacuation, sheltering and life-saving decisions. It addressed critical ESF10 issues such as cleanup and decontamination decisions, drinking water safety, critical infrastructure operations (DWTP), infrastructure decontamination I-94, waste handling and disposal, agricultural lands decontamination and more.

The EPA players represented three distinct EPA roles and responsibilities: 1) FRMAC, 2) Advisory Team and 3) ESF10/Region. It is important and sometimes difficult to stay in our respective lanes while being effective and proactive in supporting the state and appearing united as EPA. Other than a little early confusion as to who represented who on what issues, I think we handled our distinct responsibilities cooperatively and effectively and supported each other.

I promised Gene that I would send feed-back to R5 Removal Managers about the exercise. That feed-back will be related to ESF10, EPA response and cleanup, and coordinating with the state on those many response and cleanup issues we discussed during the exercise. I will be doing that in the next week or two. One of my comments will be my frustration that EPA does not have a national (or Regional) response and cleanup plan or even a strategy for a wide-area radiation incident, including a plan for handling low activity wastes although we exercise IND, RDD and nuke plant disasters yearly!

However, I have one significant concern that is not ESF10, per se, but in my view could seriously undermine the overall response including ESF10. It's about some of the "PAG" products FRMAC produced. Wow! I was awed by the some FRMAC products. I had no idea. I am used to seeing 1 year, 2 year, 50 year public dose PAGs. I understood that there are PAGs related to milk and other Ag products but I had never seen them. I had no idea there were PAGs for eggs versus chickens. Pigs versus cattle. There was a PAG for deer hunting, soybeans, corn, and wild rice. Wild rice! I never imagined. I do wonder about the data, science and research behind these more and more specific products. Never-the-less, there were three PAG products that really struck me: The non-radiation worker protection PAG; and the 5 and 10 year dairy and meat embargo PAGs. Seeing them side by side with the public dose PAGs was eye opening and concerning. The public exposure PAG restricted living (public access) about 1.5 miles down wind of the accident. The non-radiation worker PAG area was significantly larger. The 5 and 10 year beef and dairy PAGs dwarfed both. They extended 50 miles and more.

The non-radiation worker protection PAG is the easier of the two to consider. I understand that the worker PAG is different from public dose PAGs by design—although OSHA worker protection levels for substances other than radionuclides typically are significantly higher, orders of magnitude higher, not lower, than allowable public exposure levels. At Northern Lights allowable worker radiation exposures were significantly lower than exposures allowed for the general public. So at Northern lights it is OK for the general public—families—to live there but it's not OK for the garbage collector to pick up the garbage, for the postal workers to deliver mail, for the home health care worker to see to grandma's medication and therapy. It is a public administration catch 22. It is OK to live there but you can't work there. That doesn't work. It makes no sense as a policy or as a public message. These PAGs need to be de-conflicted.

The long-term dairy and meat PAG issues are more complicated and raise other difficult questions. I understand modeling the immediate embargo of livestock, dairy products, and crops directly exposed to the plume and immediate deposition from the accident. My concern is for the PAG products modeling meat and dairy restrictions five and ten years later. The beef and dairy restrictions extended 50 miles and more five to ten years later. Based upon the PAG products, the decision by state officials was that it was OK for the public to live 1.5 miles directly down wind of the accident immediately after the accident but it was not alright to raise dairy cows 50 miles down wind 10 years later! It's OK for lactating mothers and their babies to live immediately next door but not OK for lactating cows 50 miles away 10 years later. I don't want to be the PIO or Governor having to sell that message!

I didn't pay attention but I suspect the Cesium 137 soil concentrations 50 miles down wind are an order of magnitude and more lower than soil concentrations 1.5 miles down wind. Human mothers and babies are directly exposed to much higher doses. But it is not just the higher doses versus lower doses, it is direct exposure versus indirect exposure. Indeed it is indirect exposures three times removed. In subsequent years, the grass has to uptake the Cesium 137 from the soil first. Next, the cow has to uptake the Cesium 137 from the grass. And finally the public has to take up the Cesium 137 from the dairy product. That is several orders removed from much lower concentrations.

I have two questions:

1. Are the meat and dairy PAGs based upon equal protectiveness values and exposure assumptions?

They should be. If they aren't it won't fly.

2. Why do we model these PAGs at all?

Why do we model any PAG that can be timely measured with quality analyses later? We use models to make real-time emergency decisions to immediately protect public health and safety when we don't have hard data. In 2, 5, 10 years we can put in place a monitoring program to test the milk and beef. Regardless of what future testing shows these maps already proved the milk is unsafe.

I have been implementing and explaining cleanup decisions and risk values for EPA for over thirty years. I understand risk calculations. I am skeptical. I don't think we will be able to "message" these discordant values so the public will accept them. I am afraid these PAGs will cause justifiable concern and cause the public to question all our recommendations.

You may have been surprised by my comments about the PAG products in my after action comments when I didn't raise them earlier. I didn't speak up during the exercise because it was outside my lane as a player representing EPA R5 ESF10 response in the exercise.

Thanks Bill

**That was an Exercise. That was an Exercise.
What an Exercise!**

To: Cardarelli, John[Cardarelli.John@epa.gov]
From: Steuteville, William
Sent: Wed 10/26/2016 8:56:56 PM
Subject: Re: Thank You and Northern Lights Comments

I thought you might appreciate it. However, it is ORIA's job to work this with Federal partners. You are welcome to cite me talking inside EPA. I would prefer you don't use me outside EPA unless ORIA is onboard. Great working with you again. Bill

Sent from my iPhone

On Oct 26, 2016, at 4:48 PM, Cardarelli, John <Cardarelli.John@epa.gov> wrote:

Bill,

It was great working with you too last week.

Your comments are excellent and you deliver them in such an entertaining but serious way. I'm curious to see how ORIA addresses them or not. If I'm engaged in future exercise with FRMAC or the A-Team, I'm going to reference your comments to see how they will deal with it.

I like to stress the exit strategy early so we can de-conflict the issues you raised in an objective and transparent process. For example, our recommendations should depend on the environmental and personal measurements during the response and recovery periods. If the models don't pass the "laugh test", the following criteria will be used: (1) actual measurement data will trump modelled results, (2) After X months/years of measured data on Y metrics that fall below Z levels, the following actions can occur 1- reduce monitoring frequency, 2 – reduce sample types (e.g. rely on real-time instrument result vs. laboratory results), 3 – reduce or eliminate restrictions, and 4 – free release. The sooner we establish the criteria, the quicker society gets back to normal and it will build resiliency at the same time.

Bottom line – you pointed out common sense issues with modeling PAGs and demonstrated why we shouldn't blindly accept a model, especially if it conflicts with common sense and we would have real measurement data anyway.

Great job!

...John

From: Steuteville, William

Sent: Wednesday, October 26, 2016 3:34 PM

To: Jablonowski, Eugene <jablonowski.eugene@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Snead, Kathryn <Snead.Kathryn@epa.gov>; Cardarelli, John <Cardarelli.John@epa.gov>; Hallam, Christopher <Hallam.Christopher@epa.gov>

Cc: Veal, Lee <Veal.Lee@epa.gov>; Gross, Bonnie <Gross.bonnie@epa.gov>; Borries, Samuel <borries.samuel@epa.gov>; Aquino, Marcos <Aquino.Marcos@epa.gov>

Subject: Thank You and Northern Lights Comments

This is an Exercise. This is an Exercise.

Hi all!

I wanted to tell you how much I appreciated participating in Northern Lights 2016. I learned a great deal and enjoyed it more than other exercises. I enjoyed working with you. I am proud of the coordination and cooperation of all the EPA players representing R5 (me?!?), ORIA RERT including the labs, A Team, and PIO, and OLEM CMAD, as well as folks from NHSRC (and others from OEM and ORCR) who dropped everything to consult remotely and provide products to support the EPA players and the exercise. They made us look good! It was a very successful collaboration. If I missed any EPA programs that supported Northern Lights, I apologize. Northern Lights 2016 was far and away the most successful demonstration I have seen of the FRMAC and Advisory Team as assets to support “state” decision making. It also got to issues beyond evacuation, sheltering and life-saving decisions. It addressed critical ESF10 issues such as cleanup and decontamination decisions, drinking water safety, critical infrastructure operations (DWTP), infrastructure decontamination I-94, waste handling and disposal, agricultural lands decontamination and more.

The EPA players represented three distinct EPA roles and responsibilities: 1) FRMAC, 2) Advisory Team and 3) ESF10/Region. It is important and sometimes difficult to stay in our respective lanes while being effective and proactive in supporting the state and appearing united as EPA. Other than a little early confusion as to who represented who on what issues, I think we handled our distinct responsibilities cooperatively and effectively and supported each other.

I promised Gene that I would send feed-back to R5 Removal Managers about the exercise. That feed-back will be related to ESF10, EPA response and cleanup, and coordinating with the state on those many response and cleanup issues we discussed during the exercise. I will be doing that in the next week or two. One of my comments will be my frustration that EPA does not have a national (or Regional) response and cleanup plan or even a strategy for a wide-area radiation incident, including a plan for handling low activity wastes although we exercise IND, RDD and nuke plant disasters yearly!

However, I have one significant concern that is not ESF10, per se, but in my view could seriously undermine the overall response including ESF10. It's about some of the "PAG" products FRMAC produced. Wow! I was awed by the some FRMAC products. I had no idea. I am used to seeing 1 year, 2 year, 50 year public dose PAGs. I understood that there are PAGs related to milk and other Ag products but I had never seen them. I had no idea there were PAGs for eggs versus chickens. Pigs versus cattle. There was a PAG for deer hunting, soybeans, corn, and wild rice. Wild rice! I never imagined. I do wonder about the data, science and research behind these more and more specific products. Never-the-less, there were three PAG products that really struck me: The non-radiation worker protection PAG; and the 5 and 10 year dairy and meat embargo PAGs. Seeing them side by side with the public dose PAGs was eye opening and concerning. The public exposure PAG restricted living (public access) about 1.5 miles down wind of the accident. The non-radiation worker PAG area was significantly larger. The 5 and 10 year beef and dairy PAGs dwarfed both. They extended 50 miles and more.

The non-radiation worker protection PAG is the easier of the two to consider. I understand that the worker PAG is different from public dose PAGs by design—although OSHA worker protection levels for substances other than radionuclides typically are significantly higher, orders of magnitude higher, not lower, than allowable public exposure levels. At Northern Lights allowable worker radiation exposures were significantly lower than exposures allowed for the general public. So at Northern lights it is OK for the general public—families—to live there but it's not OK for the garbage collector to pick up the garbage, for the postal workers to deliver mail, for the home health care worker to see to grandma's medication and therapy. It is a public administration catch 22. It is OK to live there but you can't work there. That doesn't work. It makes no sense as a policy or as a public message. These PAGs need to be de-conflicted.

The long-term dairy and meat PAG issues are more complicated and raise other difficult questions. I understand modeling the immediate embargo of livestock, dairy products, and crops directly exposed to the plume and immediate deposition from the accident. My

concern is for the PAG products modeling meat and dairy restrictions five and ten years later. The beef and dairy restrictions extended 50 miles and more five to ten years later. Based upon the PAG products, the decision by state officials was that it was OK for the public to live 1.5 miles directly down wind of the accident immediately after the accident but it was not alright to raise dairy cows 50 miles down wind 10 years later! It's OK for lactating mothers and their babies to live immediately next door but not OK for lactating cows 50 miles away 10 years later. I don't want to be the PIO or Governor having to sell that message!

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I have been implementing and explaining cleanup decisions and risk values for EPA for over thirty years. I understand risk calculations. I am skeptical. I don't think we will be able to "message" these discordant values so the public will accept them. I am afraid these PAGs will cause justifiable concern and cause the public to question all our recommendations.

You may have been surprised by my comments about the PAG products in my after action comments when I didn't raise them earlier. I didn't speak up during the exercise because it was outside my lane as a player representing EPA R5 ESF10 response in the exercise.

Thanks Bill

That was an Exercise. That was an Exercise. What an Exercise!

To: OAR-ORIA-Clips[OARORIAclips@epa.gov]
Cc: Sanders, Roberta[Sanders.Roberta@epa.gov]
From: Sanders, Roberta
Sent: Wed 7/27/2016 5:15:01 PM
Subject: Fw:(clips) Radiation clips 7/27/2016



Radiation News Clips

July 27, 2016

EPA

Environmental Groups Oppose EPA Draft Radiological Events Water Guide (insideepa)

<http://insideepa.com/daily-news/environmental-groups-oppose-epa-draft-radiological-events-water-guide>

Environmental groups are strongly criticizing EPA's draft drinking water amendments to protective action guides (PAGs) for radiological emergencies, arguing the plan would allow radionuclide concentrations far beyond Safe Drinking Water Act (SDWA) limits and disparaging the agency for failing to disclose concentration levels for most of the radionuclides under the guidance.

EPA Weighs Comments on Drinking Water PAG; LGAC Panels Meet on Broad Topics (insideepa.com)

<http://insideepa.com/the-week-ahead>

Stakeholders are due to submit comments this week on EPA's controversial update to the protective action guides (PAGs) for dealing with drinking water contaminated by a nuclear accident.

Radioactive Waste

[Judge says he won't dismiss illegal radioactive waste meeting lawsuit](http://bismarcktribune.com) (bismarcktribune.com)

http://bismarcktribune.com/bakken/judge-says-he-won-t-dismiss-illegal-radioactive-waste-meeting/article_fca5bc41-76f3-52e1-974e-0ba6d364eac3.html

A court judge said Tuesday he won't dismiss a suit against the state Health Council for holding an illegal public meeting when it approved rules for a new radioactive waste disposal in North Dakota last year.

WIPP

WIPP Update: Backup Power Installed for WIPP EOC (ladailypost)

<http://www.ladailypost.com/content/wipp-update-backup-power-installed-wipp-eoc>

The Waste Isolation Pilot Plant's (WIPP) Emergency Operations Center (EOC) will soon have guaranteed operation in the event of a power outage.

Hanford

Safety equipment shortage sends Hanford workers home (TCH)

<http://www.tri-cityherald.com/news/local/hanford/article91843017.html>

About 65 construction workers have been sent back to their union halls as some work has been cut back at the Hanford tank farms, a fallout of a new policy to protect workers from chemical vapors.

Safety and Security

Nuclear Industry Calls for More Predictable Reviews at NRC (bna)

http://esweb.bna.com/eslw/1245/split_display.adp?fedfid=94650610&vname=dennotallissues&jd=a0j8n9r8k8&split=0

The Nuclear Regulatory Commission needs to increase the predictability and efficiency of its regulatory review process, particularly for new advanced reactors in the development stage, representatives from the nuclear and utility industries told the agency.

Health

Some brain cancer patients have radiation options, study finds (upi.com)

http://www.upi.com/Health_News/2016/07/26/Some-brain-cancer-patients-have-radiation-options-study-finds/9101469576149/

For some brain cancer patients, pinpoint radiation of tumors, known as stereotactic radiosurgery, appears to do less damage to mental abilities than whole brain radiation, a new study finds.

Nuclear Power

N.J. reactor shuts down for 4th time in a month (greenwire)

<http://www.eenews.net/greenwire/stories/1060040788/search?keyword=nuclear>

A nuclear power plant in New Jersey has been shut down for the fourth time in a month after problems with its main generator.

Sticker Shock: The Soaring Costs of Germany's Nuclear Shutdown (yaleenvironment360)

http://e360.yale.edu/feature/soaring_cost_german_nuclear_shutdown/3019/

The cavern of the salt mine is 2,159 feet beneath the surface of central Germany. Stepping out of a dust-covered Jeep on an underground road, we enter the grotto and are met by the sound of running water — a steady flow that adds up to 3,302 gallons per day. "This is the biggest problem," Ina Stelljes, spokesperson for the Federal Office for Radiation Protection, tells me, gesturing to a massive tank in the middle of the room where water waits to be pumped to the surface.

China is developing a floating nuclear power station that could be deployed to the South China Sea (businessinsider.com)

<http://www.businessinsider.com/china-developing-nuclear-power-on-boat-2016-7>

While tensions are flaring in the South China Sea, recent reports from leading Chinese nuclear engineers won't be relieving that sentiment any time soon — according to ChinaDaily, the country is now developing a new vessel-installed nuclear power station.

Science

Improving safety of neutron sources (eurekalert.org)

http://www.eurekalert.org/pub_releases/2016-07/s-iso072716.php

There is a growing interest in the scientific community in a type of high-power neutron source that is created via a process referred to as spallation. This process involves accelerating high-energy protons towards a liquid metal target made of material with a heavy nucleus.

Space/Cosmic Radiation

NASA releases 'Microbiomics: The Living World In and On You' (eurekalert.org)

http://www.eurekalert.org/pub_releases/2016-07/nsc-nr072616.php

NASA's Human Research Program (HRP) is releasing a video titled "Microbiomics: The Living World In and On You" to highlight microbial research on the International Space Station. HRP's Twins Study uses omics to study Scott and Mark Kelly's microbiome, which is the collection of each individual's microbes.

Other

N. Korea warns US of 'terrifying price' over nuke tensions (washingtonpost)

https://www.washingtonpost.com/world/asia_pacific/kerry-says-world-determined-to-stop-nkoreas-nuclear-plans/2016/07/26/52e41e6c-52fe-11e6-b652-315ae5d4d4dd_story.html

North Korea warned the United States on Tuesday that it will pay a "terrifying price" if the Korean Peninsula sinks into deeper tensions, stepping up its rhetoric hours after U.S. Secretary of State John Kerry blasted Pyongyang for its nuclear program.

Expert panel declines to recommend routine full-body screening for skin cancer (washingtonpost)

<https://www.washingtonpost.com/news/to-your-health/wp/2016/07/26/expert-panel-declines-to-recommend-routine-full-body-screening-for-skin-cancer/>

A panel of medical experts said Tuesday that there's too little evidence to determine whether routine full-body screening for skin cancer saves lives.

Hinkley C investment decision: A new dawn for UK nuclear power? (Platts)

<http://blogs.platts.com/2016/07/27/hinkley-c-uk-nuclear-power/>

The long-awaited final investment Decision (FID) for EDF Energy's planned 3,200-MW Hinkley Point C nuclear power station in western England, scheduled to take place at a board meeting of French utility EDF in Paris July 28, will not only give the go ahead for the first new nuclear plant in the UK since 1995, but could also serve as the starting gun for a total of 16,000 MW of new nuclear capacity due to be built in the country.

To: Stevenson, Benjamin <Benjamin.Stevenson@hq.dhs.gov>
(Benjamin.Stevenson@hq.dhs.gov)[Benjamin.Stevenson@hq.dhs.gov]
Cc: Hall, John[Hall.John@epa.gov]; Lee, Sangdon[Lee.Sangdon@epa.gov]; Magnuson,
Matthew[Magnuson.Matthew@epa.gov]; Cardarelli, John[Cardarelli.John@epa.gov]
From: Lemieux, Paul
Sent: Thur 7/21/2016 7:25:25 PM
Subject: Cleared Task 3 report
[WA 5-34 EPA Operational Guidelines - May 2016 r7.pdf](#)

Ben:

I got the last of the program office signatures today. Here is the “non-508-compliant” version of the Task 3 report. It is EPA report number EPA/600/R-15/317.

The formatting people will go about making it 508 compliant and when that version gets completed I’ll send it to you too. The text won’t change again though.

Paul M. Lemieux, PhD
US EPA Office of Research and Development
National Homeland Security Research Center
Associate Division Director
NHSRC/DCMD
919-541-0962
919-541-0496 fax
513-300-9958 cell
lemieux.paul@epa.gov
www.epa.gov/nhsrc

To: Veal, Lee[Veal.Lee@epa.gov]
Cc: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]; Edwards, Jonathan[Edwards.Jonathan@epa.gov]
From: Christ, Lisa
Sent: Fri 10/9/2015 5:58:29 PM
Subject: Re: Mike's comments

Thanks Lee

Sent from my iPhone

On Oct 9, 2015, at 12:33 PM, Veal, Lee <Veal.Lee@epa.gov> wrote:

Dear Sam,

Mike Flynn has completed his review of the package, and has some edits for the package. He is prepared to take a final package to Janet McCabe today, so when you have final documents, please advise and I'll make a hard copy package. I am in today in EPA west if you need me.

1. ACTION MEMO 8/21/2015. Currently has both Mike and Peter's signatures. You do not need to have Mike as a signatory, but we would like to have an introductory sentence that says something like "As you know, we have been working closely with the Office of Radiation and Indoor Air on the development of drinking water guidance for use during radiological emergencies." Or something your office likes better.
2. ACTION MEMO 8/21/2015, 2nd page, 2nd full paragraph, 3rd sentence make one sentence align with earlier changes from Lisa Christ. It should read "The Agency determined that it may not be appropriate to base response measures during short-term emergency incidents...."
3. ACTION MEMO 8/21/2015, last page, STAFF CONTACT. Should this be Lisa Christ? Please leave Sara on there as the overall PAG Manual lead, but list Lisa first as primary DW contact.
4. FEDERAL REGISTER NOTICE. Page 5, top of page. Please add a reference on where the 2013 PAG Manual can be found. <http://www2.epa.gov/radiation/protective-action-guides-pags>

5. FEDERAL REGISTER NOTICE. Page 7, Question E. Might be passive voice.
Suggest changing sentence to: "Once comments on this addition have been addressed, EPA will add drinking water guidance to the full PAG Manual which...."

6. PROPOSAL. No changes.

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

THANK YOU SO MUCH!

Lee

Lee Ann B. Veal

Director, Center for Radiological Emergency Management

Radiation Protection Division

Office of Radiation and Indoor Air

Office: 202-343-9448


Cell: 202-617-4322

www.epa.gov/radiation

To: Burneson, Eric[Burneson.Eric@epa.gov]
From: Christ, Lisa
Sent: Thur 10/8/2015 9:16:19 PM
Subject: FYI -- Revised drinking water PAG proposal for Peter and Mikes' review
Redline proposal with changes 10-7-2015.docx

Eric-

We've cleared OSWER review and are preparing the proposal for Ken and Janet's review before sending to OP for transmittal to OMB.

 Sam is presenting at the PR workshop next week but can be reached by email, Jerry is ~~presenting at the PR workshop next week but can be reached by email, Jerry is~~ revisions are needed. We'll continue coordinating with ORIA on this. I've left a hard copy for you and also for Peter.

Lisa

From: Christ, Lisa
Sent: Wednesday, October 07, 2015 4:30 PM
To: Grevatt, Peter
Cc: Burneson, Eric; Hernandez-Quinones, Samuel; Ellis, Jerry
Subject: FW: OSWER Comments on 10-02-2015 Revisions to DW PAG and FR NODA

Hi Peter,

Sara, Lee and I have agreed with the revisions in the attached proposal and summarized below. Alan and Jon are reviewing as well. Please let me know if there are any other changes you would like.

In addition, we are taking a last look at the communication materials that will be needed to transmit the package to OP for OMB review. Our goal is to have the complete package ready to go to Ken and Janet on Friday for review/transmittal to OP.

Let me know if you have any questions or concerns-

Lisa

From: Christ, Lisa
Sent: Wednesday, October 07, 2015 2:11 PM
To: DeCair, Sara; Veal, Lee
Subject: FW: OSWER Comments on 10-02-2015 Revisions to DW PAG and FR NODA

I've taken the first crack at updating the proposal. See below and attached.

We can talk at 4pm

From: Grevatt, Peter
Sent: Wednesday, October 07, 2015 12:57 PM
To: Flynn, Mike; DeCair, Sara; Christ, Lisa
Cc: Oshida, Phil; Edwards, Jonathan
Subject: RE: OSWER Comments on 10-02-2015 Revisions to DW PAG and FR NODA

Thanks Mike. Lisa and Sara, I wonder whether you can take a quick look at the suggestions that Mike and I have provided below. If there are minor additional changes we can make that would be helpful, I recommend that we do so, but none of the issues identified prevent us from going forward to the next step in our process and I recommend that we do so asap. Thanks again for all of your great work on this!

From: Flynn, Mike
Sent: Wednesday, October 07, 2015 12:49 PM
To: Grevatt, Peter
Subject: Re: OSWER Comments on 10-02-2015 Revisions to DW PAG and FR NODA

On travel....here's quick reaction -

1. Think our folks might be able to add a little language that might help here as you suggest but agree we are mostly there. Also, the sentence we didn't include that points out food and DW PAGs both factor in water from consumption and diet might help

I added a sentence to address Peter's suggestion and added in the sentence we deleted from the food/water PAG discussion (pg. 2)

2. Agree, easy thing to do

I changed the header to "Other Standards" (pg. 5)

3. Not sure, but assume could soften language as you suggest

Changed to "may" per Peter's suggestion (pg. 5)

Suggest we have our folks quickly look at.

Mike

Sent from my iPhone

On Oct 7, 2015, at 11:26 AM, Grevatt, Peter <Grevatt.Peter@epa.gov> wrote:

Regarding OSWER's 3 bullets:

- 1) I think we address this already in our discussion. Is there a way that we can be even more specific about the need to consider the use of each of the individual PAG sections depending on the specific conditions facing a community?
- 2) Not a big deal to me either way

Ex. 5 - Deliberative Process

Please let me know what you think.

From: Hostage, Barbara
Sent: Wednesday, October 07, 2015 11:00 AM
To: Grevatt, Peter; Flynn, Mike
Cc: Woolford, James; Cheatham, Reggie; Tulis, Dana
Subject: OSWER Comments on 10-02-2015 Revisions to DW PAG and FR NODA
Importance: High

Good morning, Peter & Mike.

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Thank you again for the opportunity to participate in the development of these important Significant Guidance Documents. We look forward to continue a close working relationship with you as you move forward.

Barbara Hostage, Director

Policy Analysis and Regulatory Management Staff (PARMS)
Office of Program Management (OPM)
Office of Solid Waste and Emergency Response (OSWER)

EPA West Room 4130A
Phone Number: 202-566-1933
Fax Number: 202-566-1934
Mail Code: 5103T

To: Ellis, Jerry[Ellis.Jerry@epa.gov]
Cc: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Thur 10/8/2015 12:19:28 PM
Subject: FW: Example transmittal memos
[FR Letter Ray to Director of FR 3-13-2013.doc](#)
[PAGs FR Notice Memo Mike to Gina 3-14-2013 v2.doc](#)
[Transmittal from Flynn to McCarthy RPD Final 04012013.pdf](#)

Hi Jerry –

Please prepare draft memos for the drinking water PAG. Examples are attached. The FRN and transmittal memo should be from Peter to Ken. Please check in with Stephanie to see if the “template” or format has changed. We’re hoping to get the full package to Peter for review tomorrow and to the AAs, Ken and Janet, next week. Sorry for the quick turnaround after we’ve been in hold mode so long...

Lisa

From: DeCair, Sara
Sent: Wednesday, October 07, 2015 5:07 PM
To: Christ, Lisa
Cc: Veal, Lee
Subject: Example transmittal memos

Lisa,

I have a few examples in my old FR files here. I hope they are useful! Even though the package is not really headed for the FR at this time, the draft memos are needed as if it is.

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Wed 10/7/2015 2:43:25 PM
Subject: PAG documents for OSWER review
[FR Notice drinking water PAG 10-2-2015.docx](#)
[OGWDW-ORIA response to OSWER comments 10-2-2015.docx](#)
[Redline proposal with 4 changes 10-2-2015 OGWDW.docx](#)
[Timeline for PAG Manual 10-2-2015.docx](#)

Sam & Jerry –

I wanted to make sure you have the most recent version of materials that are at OSWER for “show stopper” review. We’ve asked for them to get back to Peter and Mike by COB tomorrow. I’ve heard from OSRTI and they’ve confirmed no show stoppers for them. Once we have OSWER signoff, we will need to work with ORIA to quickly address comments and get the package to OP.

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW  
Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M

**To:** Grevatt, Peter[Grevatt.Peter@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]; Flynn, Mike[Flynn.Mike@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]  
**Cc:** Veal, Lee[Veal.Lee@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Fri 10/2/2015 8:38:58 PM  
**Subject:** RE: Edited drinking water PAG documents

## Ex. 5 - Deliberative Process

**From:** Grevatt, Peter  
**Sent:** Friday, October 02, 2015 4:31 PM  
**To:** DeCair, Sara; Flynn, Mike; Perrin, Alan; Christ, Lisa  
**Cc:** Veal, Lee  
**Subject:** RE: Edited drinking water PAG documents

## Ex. 5 - Deliberative Process

**From:** DeCair, Sara  
**Sent:** Friday, October 02, 2015 4:14 PM  
**To:** Flynn, Mike; Grevatt, Peter; Perrin, Alan; Christ, Lisa  
**Cc:** Veal, Lee  
**Subject:** Edited drinking water PAG documents

Mike and Peter,

We took out the sentence below that we heard maybe should be cut -- or maybe should be kept. We think it'd be easier to cut it but if not, it should have a few edits for better clarity. If you want it back in, just let me know. See what you think of the four attachments for sending to OSWER. Thank you!

## Ex. 5 - Deliberative Process

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

**To:** DeCair, Sara[DeCair.Sara@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Fri 10/2/2015 7:42:10 PM  
**Subject:** RE: 3 edited docs for ODs then OSWER

## Ex. 5 - Deliberative Process

**From:** DeCair, Sara  
**Sent:** Friday, October 02, 2015 2:20 PM  
**To:** Perrin, Alan; Christ, Lisa  
**Subject:** 3 edited docs for ODs then OSWER

Lisa,

Alan already looked at these and I think (hope!) they do what the ODs wanted from us. I'm glad to send them up now if you think that's helpful, or we can wait til we've had a chance to review each other's documents and put all four things together in one message. Up to you,

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

**To:** DeCair, Sara[DeCair.Sara@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Fri 10/2/2015 7:33:29 PM  
**Subject:** RE: 3 edited docs for ODs then OSWER  
OGWDW-ORIA response to OSWER comments 10-2-2015.docx

Sorry for the delay

**From:** DeCair, Sara  
**Sent:** Friday, October 02, 2015 2:20 PM  
**To:** Perrin, Alan; Christ, Lisa  
**Subject:** 3 edited docs for ODs then OSWER

Lisa,

Alan already looked at these and I think (hope!) they do what the ODs wanted from us. I'm glad to send them up now if you think that's helpful, or we can wait til we've had a chance to review each other's documents and put all four things together in one message. Up to you,

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

**To:** Greene, Ashley[Greene.Ashley@epa.gov]; Galada, Heather[Galada.Heather@epa.gov]  
**Cc:** Mason, Paula[Mason.Paula@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Wed 9/30/2015 7:42:57 PM  
**Subject:** Materials for Peter's OD call with OSWER re: radiation PAG  
OGWDW-ORIA response to OSWER comments 9-30-2015.docx

Hi All-

Attached is a document that describes how OGWDW/ORIA addressed OSWER comments. This is for discussion at tomorrow's call.

Thanks-

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: Veal, Lee[Veal.Lee@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Thur 9/24/2015 12:23:21 PM
Subject: RE: PAG comment responses

Hi All –

Let's talk this morning, if possible, about how to tackle the re-writes. I'll take a crack at summarizing the feedback from yesterday. My Outlook calendar is up to date and I'm not too busy today. It looks like y'all may have an all-day meeting/activity?

Lisa

From: Veal, Lee
Sent: Wednesday, September 23, 2015 5:24 PM
To: Christ, Lisa
Cc: DeCair, Sara; Hernandez-Quinones, Samuel
Subject: Re: PAG comment responses

Hi

Based on today's call, would you like for us to take the pen, or do you guys want to? We are flexible. Sara will work on the FDA language either way.

Lee

Lee Ann B Veal

Director, Center for Radiological Emergency Management

Office of Radiation and Indoor Air

USEPA

Office 202-343-9448

Cell 202-617-4322

On Sep 22, 2015, at 4:06 PM, Christ, Lisa <Christ.Lisa@epa.gov> wrote:

Revised version attached – let me know what you think...

TY-

Lisa

From: DeCair, Sara
Sent: Monday, September 21, 2015 1:52 PM
To: Christ, Lisa; Veal, Lee
Subject: PAG comment responses

Lisa,

I like all Alan's suggestions and am attaching a clean copy. I also think this redline version of the chapter, attached, properly addresses the three items we decided on – see if you think it looks okay? We have a few options on legal disclaimers, and several good points about food and water and we can choose any subset you like. Many thanks!

Sara

From: Perrin, Alan
Sent: Friday, September 18, 2015 6:57 PM
To: DeCair, Sara; Christ, Lisa
Cc: Edwards, Jonathan
Subject: RE: Next to Alan: Responses

You two did a great job on this. Both Jon and I had a chance to look at it this afternoon. The attached includes some additional formatting (mostly to add a bit of OW blue to the sheet along with some white space) – I just accepted those changes to keep track changes

manageable. It also includes some text additions (available in track changes), especially to the Q on cumulative risk. Please take a look and decide what will work for the Wednesday ODs briefing. Thanks again for your hard work! -Alan

Alan Perrin, Deputy Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: DeCair, Sara
Sent: Thursday, September 17, 2015 5:00 PM
To: Christ, Lisa; Perrin, Alan
Subject: Next to Alan: Responses

Lisa, I incorporated all your suggestions and Alan says he would like to provide a little formatting help tomorrow (as well as go over what we've done). This will be perfect material for our meeting next Wednesday, and I offered to do a redline with the three changes we agreed we should make. I can get that done Monday and share it with you. Thank you again for being so helpful in getting through this very wearying process!

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

<OGWDW-ORIA response to OSWER comments 9-18-2015_LC.docx>

To: DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Thur 9/24/2015 7:33:47 PM
Subject: revised response to OSWER comments
[OGWDW-ORIA response to OSWER comments 9-24-2015 trackchange.docx](#)
[OGWDW-ORIA response to OSWER comments 9-24-2015 clean.docx](#)

Hi All –

Based on my notes from yesterday's call, I've revised the response document and highlighted the issues Mike and Peter will discuss with the OSWER ODs. Let me know if this doesn't jive with what you heard or could be better described.

Thanks all in advance –

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW  
Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M

**To:** Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Wed 9/23/2015 6:55:43 PM  
**Subject:** FW: Updated response to OSWER cmts & same draft redline water PAG proposal  
[OGWDW-ORIA response to OSWER comments 9-22-2015.docx](#)  
[Redline Water Protective Action Guide 9-21-2015.docx](#)

**From:** DeCair, Sara  
**Sent:** Tuesday, September 22, 2015 5:05 PM  
**To:** Flynn, Mike; Edwards, Jonathan; Perrin, Alan; Veal, Lee; Cherepy, Andrea; Cheng, Deborah  
**Cc:** Christ, Lisa  
**Subject:** Updated response to OSWER cmts & same draft redline water PAG proposal

Mike,

Lisa Christ, Sam Hernandez, Lee and I spoke this afternoon and went through each of the responses to make sure we were as positive as possible about each and every comment. We have edited language, an additional possible compromise and a couple areas where we need yours and Peter's input in particular.

The attached responses and redline version of the water PAG proposal make up the materials for tomorrow's conference call with OGWDW at 4 pm. Do let me know if you need anything else.

Sara

**To:** Greene, Ashley[Greene.Ashley@epa.gov]  
**Cc:** Mason, Paula[Mason.Paula@epa.gov]; Galada, Heather[Galada.Heather@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Tue 9/22/2015 8:37:05 PM  
**Subject:** FW: PAG comment responses  
[OGWDW-ORIA response to OSWER comments 9-22-2015.docx](#)

Hello –

Attached are materials for tomorrow's OD meeting (OGWDW and ORIA) on the PAG.

Lisa

**From:** DeCair, Sara  
**Sent:** Tuesday, September 22, 2015 4:31 PM  
**To:** Christ, Lisa; Veal, Lee  
**Cc:** Hernandez-Quinones, Samuel  
**Subject:** Re: PAG comment responses

Awesome. I accepted all the changes and only edited tense in the first response and made 'section' singular later on. Thank you so much for this!

I'm sending it up with the redline to Mike Flynn and Jon and Alan for tomorrow's meeting. Have a relaxing evening,

Sara

---

**From:** Christ, Lisa  
**Sent:** Tuesday, September 22, 2015 4:05 PM  
**To:** DeCair, Sara; Veal, Lee  
**Cc:** Hernandez-Quinones, Samuel  
**Subject:** RE: PAG comment responses

Revised version attached – let me know what you think...

TY-

Lisa

**From:** DeCair, Sara  
**Sent:** Monday, September 21, 2015 1:52 PM  
**To:** Christ, Lisa; Veal, Lee  
**Subject:** PAG comment responses

Lisa,

I like all Alan's suggestions and am attaching a clean copy. I also think this redline version of the chapter, attached, properly addresses the three items we decided on – see if you think it looks okay? We have a few options on legal disclaimers, and several good points about food and water and we can choose any subset you like. Many thanks!

Sara

**From:** Perrin, Alan  
**Sent:** Friday, September 18, 2015 6:57 PM  
**To:** DeCair, Sara; Christ, Lisa  
**Cc:** Edwards, Jonathan  
**Subject:** RE: Next to Alan: Responses

You two did a great job on this. Both Jon and I had a chance to look at it this afternoon. The attached includes some additional formatting (mostly to add a bit of OW blue to the sheet along with some white space) – I just accepted those changes to keep track changes manageable. It also includes some text additions (available in track changes), especially to the Q on cumulative risk. Please take a look and decide what will work for the Wednesday ODs briefing. Thanks again for your hard work! -Alan

---

Alan Perrin, Deputy Director  
Radiation Protection Division, USEPA

ofc (202) 343-9775 | mbl (202) 279-0376

**From:** DeCair, Sara  
**Sent:** Thursday, September 17, 2015 5:00 PM  
**To:** Christ, Lisa; Perrin, Alan  
**Subject:** Next to Alan: Responses

Lisa, I incorporated all your suggestions and Alan says he would like to provide a little formatting help tomorrow (as well as go over what we've done). This will be perfect material for our meeting next Wednesday, and I offered to do a redline with the three changes we agreed we should make. I can get that done Monday and share it with you. Thank you again for being so helpful in getting through this very wearying process!

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

**To:** Clark, Becki[Clark.Beki@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Mon 9/21/2015 8:30:46 PM  
**Subject:** Drinking Water PAG proposal - response to OSWER comments  
[OGWDW-ORIA response to OSWER comments 9-18-2015.docx](#)  
[Internal Q and A Document 8-26-2015 CLEAN.DOCX](#)

Becki,

Attached is the draft response to OSWER comments document and the internal Q&A for the drinking water PAG proposal. Eric mentioned Peter would like us to see if we can accommodate more of OSWER's comments. I will be meeting with ORIA tomorrow to discuss, so the attached draft will likely change. Let me know if you have questions or concerns.

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]
From: Christ, Lisa
Sent: Mon 9/21/2015 8:17:52 PM
Subject: RE: PAG comment responses

Let's set up time to talk tomorrow. Eric just spoke with Peter who suggested we see if there's any place we can accommodate OSWER comments.

You've already included additional language on the Food/water PAG so that's a start.

L

From: DeCair, Sara
Sent: Monday, September 21, 2015 4:08 PM
To: Christ, Lisa; Veal, Lee
Subject: RE: PAG comment responses

Alan pointed out my new sub-heading didn't wind up right, and he had a good fix for how large the footer had gotten. He does love formatting! Here is the more correct redline version of the chapter. Thanks for any suggestions. (And should I set up a call for us for tomorrow?) Our project plan says we hoped to get this to OP by Sept. 28th and that is looking unlikely.

S.

From: Christ, Lisa
Sent: Monday, September 21, 2015 3:21 PM
To: DeCair, Sara; Veal, Lee
Subject: RE: PAG comment responses

Sara –

I like Alan's suggestions as well. I briefly summarized the key issues today for Eric and reiterated that we believe we've addressed OSWER comments to the extent we are comfortable. I will take a look at the revised DW proposal and let you know my thoughts

on your revisions. We may want to talk before the meeting Wednesday to confirm our recommendations for Mike and Peter.

Thanks-

Lisa

From: DeCair, Sara
Sent: Monday, September 21, 2015 1:52 PM
To: Christ, Lisa; Veal, Lee
Subject: PAG comment responses

Lisa,

I like all Alan's suggestions and am attaching a clean copy. I also think this redline version of the chapter, attached, properly addresses the three items we decided on – see if you think it looks okay? We have a few options on legal disclaimers, and several good points about food and water and we can choose any subset you like. Many thanks!

Sara

From: Perrin, Alan
Sent: Friday, September 18, 2015 6:57 PM
To: DeCair, Sara; Christ, Lisa
Cc: Edwards, Jonathan
Subject: RE: Next to Alan: Responses

You two did a great job on this. Both Jon and I had a chance to look at it this afternoon. The attached includes some additional formatting (mostly to add a bit of OW blue to the sheet along with some white space) – I just accepted those changes to keep track changes manageable. It also

includes some text additions (available in track changes), especially to the Q on cumulative risk. Please take a look and decide what will work for the Wednesday ODs briefing. Thanks again for your hard work! -Alan

Alan Perrin, Deputy Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: DeCair, Sara
Sent: Thursday, September 17, 2015 5:00 PM
To: Christ, Lisa; Perrin, Alan
Subject: Next to Alan: Responses

Lisa, I incorporated all your suggestions and Alan says he would like to provide a little formatting help tomorrow (as well as go over what we've done). This will be perfect material for our meeting next Wednesday, and I offered to do a redline with the three changes we agreed we should make. I can get that done Monday and share it with you. Thank you again for being so helpful in getting through this very wearying process!

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Fri 9/18/2015 7:46:37 PM
Subject: RE: Papal Visit DC 9/22-24 planning

Hi Sam

Yes, I plan to come in Wednesday, but I understand that will probably be the most challenging day. I think we can set up a conference call for the meeting.

Thank you --

Lisa

From: Hernandez-Quinones, Samuel
Sent: Friday, September 18, 2015 3:41 PM
To: Christ, Lisa
Subject: Re: Papal Visit DC 9/22-24 planning

Yes I sent it to Lisa, but it looks like I forgot to cc you.

I was planning to telework on the 23 and 24, but given that the PAGs meeting is scheduled for Wednesday I still don't know if I will go to the office on the 23.

Do you plan to be in the office on Wednesday?

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

From: Christ, Lisa
Sent: Friday, September 18, 2015 3:36 PM
To: Hernandez-Quinones, Samuel
Subject: FW: Papal Visit DC 9/22-24 planning

Ex. 6 - Personal Privacy

From: Huff, Lisa
Sent: Tuesday, September 15, 2015 2:38 PM
To: OW-OGWDW-Targeting & Analysis Branch
Subject: Papal Visit DC 9/22-24 planning

Ex. 6 - Personal Privacy

Ex. 6 - Personal Privacy

Let Lisa or I know if you have any questions.

Lisa Foersom Huff

Associate Branch Chief

Targeting and Analysis Branch

Standards and Risk Management Division

Office of Groundwater and Drinking Water

U.S. EPA

EPA East Bldg. Rm. 2331 C

202-566-0787

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Fri 9/18/2015 4:15:41 PM
Subject: FW: OSWER Comments on Revised DW PAG
[OSWER Overarching comments.091115.2.docx](#)
[ATT00001.htm](#)
[Draft Protective Action Guide.combined 091515..docx](#)
[ATT00002.htm](#)

From: Grevatt, Peter
Sent: Wednesday, September 16, 2015 4:40 PM
To: Burneson, Eric; Christ, Lisa
Subject: Fwd: OSWER Comments on Revised DW PAG

FYI.

Sent from my iPhone

Begin forwarded message:

From: "Hostage, Barbara" <Hostage.Barbara@epa.gov>
Date: September 16, 2015 at 2:24:07 PM EDT
To: "Flynn, Mike" <Flynn.Mike@epa.gov>, "Grevatt, Peter" <Grevatt.Peter@epa.gov>
Subject: OSWER Comments on Revised DW PAG

Good afternoon, Mike & Peter.

OSWER thanks both OW and ORIA for the opportunity to review the revised Drinking Water (DW) Protective Action Guide (PAG). Attached you will find OSWER's comments.

Ex. 5 - Deliberative Process
provided. As such, we will need to review the next revised document. In addition, we are also preparing comments on the draft Q & A document and will share those comments once completed. Lastly, we once again request the opportunity to review/comment on the FR notice being prepared to announce the Draft DW PAG for review/comment. As mentioned previously, we are particularly interested in the "charge questions" that will focus reviewer's comments on the important elements contained in the draft PAG (**Ex. 5 - Deliberative Process**). Please let

me know if you have any questions.

Barbara Hostage, Director

Policy Analysis and Regulatory Management Staff (PARMS)
Office of Program Management (OPM)
Office of Solid Waste and Emergency Response (OSWER)

EPA West Room 4130A
Phone Number: 202-566-1933
Fax Number: 202-566-1934
Mail Code: 5103T

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Christ, Lisa
Sent: Fri 9/4/2015 1:05:17 PM
Subject: RE: FYI note from 8/27: OSWER Review of Drinking Water PAG
Water PAG FR Notice draft 9-3-2015_lc.docx

Hi Sara –

Attached are my comments on the FRN. I don't believe its responsive to Barbara's request regarding the "charge questions" however, I do want to speak to

Peter as I don't agree with her request.

Lisa

From: DeCair, Sara
Sent: Thursday, September 03, 2015 11:29 AM
To: Christ, Lisa
Subject: FYI note from 8/27: OSWER Review of Drinking Water PAG
Importance: High

Lisa,

FYI, Mike is wanting us to address all of the items Barbara lists below. I've got them well in hand, and I think the attached updated draft FR now addresses the cumulative risk thing, which we'll have to see how we all feel about...

Alan didn't have anything further on this FR so I think it's for your eyes next. I switched the point of contact to you, but would be glad to have it be me, or both of us.

If we hear anything from OSWER today, I'll touch base (but I'd be a bit surprised). Cheers,

Sara

202-343-9108

From: Hostage, Barbara
Sent: Thursday, August 27, 2015 9:29 AM
To: Tulis, Dana; Cheatham, Reggie; Woolford, James; Stalcup, Dana; Scozzafava, MichaelE; Fitz-James, Schatzi; Kudarauskas, Paul; Raffaele, Kathleen; Foster, Stiven; Cogliano, Gerain
Subject: FW: OSWER Review of Drinking Water PAG
Importance: High

fyi

From: Hostage, Barbara
Sent: Thursday, August 27, 2015 9:14 AM
To: Flynn, Mike
Cc: Grevatt, Peter
Subject: OSWER Review of Drinking Water PAG
Importance: High

Good morning, Mike.

I was just drafting this email message to you when I received your email this morning.

It was very nice seeing/speaking with you and Peter on Monday.

We look forward to seeing the redline/strikeout version of the revised draft.

We will also provide our comments on the draft Q& A document that Sara Decair shared with us on Monday afternoon.

Finally, we would like to request to review/comment on the FR notice which will announce the Draft DW PAG for review/comment.

We are particularly interested in the “charge questions” that will focus reviewer’s comments on the important elements contained in the draft PAG (

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

I want to thank you and your staff for the time and consideration in addressing OSWER concerns.

Please let me know if you have any questions.

Barbara Hostage, Director

Policy Analysis and Regulatory Management Staff (PARMS)
Office of Program Management (OPM)
Office of Solid Waste and Emergency Response (OSWER)

EPA West Room 4130A
Phone Number: 202-566-1933
Fax Number: 202-566-1934
Mail Code: 5103T

To: DeCair, Sara[DeCair.Sara@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
Cc: Veal, Lee[Veal.Lee@epa.gov]
From: Christ, Lisa
Sent: Thur 8/27/2015 11:51:50 AM
Subject: RE: New redline Water PAG chapter for your review
Clean Version 8-26-15 Edits Draft Protective Action Guide.docx
Compared Document.docx

Sara – We may need to do one last check that all comments are incorporated. Sam was also revising the document (see attached). Can you two please coordinate for one last look. Thanks –

Lisa

From: DeCair, Sara
Sent: Wednesday, August 26, 2015 5:28 PM
To: Christ, Lisa; Hernandez-Quinones, Samuel; Perrin, Alan; Edwards, Jonathan
Cc: Veal, Lee
Subject: RE: New redline Water PAG chapter for your review

Awesome. I've got one Oxford comma and one capitalization to fix and then it'll be ready to go over to OSWER in the morning. Do you all have suggestions on who should convey it, with Mike and Peter out?

Thanks—

Sara

From: Christ, Lisa
Sent: Wednesday, August 26, 2015 5:04 PM
To: DeCair, Sara; Hernandez-Quinones, Samuel; Perrin, Alan; Edwards, Jonathan
Cc: Veal, Lee
Subject: RE: New redline Water PAG chapter for your review

Sara & Sam –

Thanks for your work revising the proposal. I agree with the edits except a few which I've noted. Sam added language to section 7 to explain how we selected the most limiting concentration for the sensitive life-stages PAG in response to OSWER comments. I appreciate the effort to minimize revisions since our AA Ken has already reviewed/commented on the proposal.

Lisa

From: DeCair, Sara

Sent: Tuesday, August 25, 2015 5:44 PM

To: Hernandez-Quinones, Samuel; Christ, Lisa; Perrin, Alan; Edwards, Jonathan

Cc: Veal, Lee

Subject: New redline Water PAG chapter for your review

Before going back to OSWER for an expedited showstoppers review, please see if you can live with all the very small editorial changes that Sam, myself and Alan have made. I think this redline version strikes a perfect balance of responsiveness to OSWER's comments and preserving the intent we've had throughout the drafting process. If you don't see the changes, go to Review and click All Markup.

If a quick call would be helpful to talk about this, I'll gladly schedule something tomorrow or Thursday. It'd be ideal to get this to OSWER by the end of the week, if possible. Thank you all so much!

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

To: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]
From: Christ, Lisa
Sent: Wed 8/26/2015 6:16:40 PM
Subject: FW: Chapter Edits
8-26-15 Edits Draft Protective Action Guide.docx

Thank you Sam -- Does your attached document include all of the same comments as the version Sara sent late yesterday? Lisa

From: Hernandez-Quinones, Samuel
Sent: Wednesday, August 26, 2015 1:15 PM
To: Christ, Lisa
Subject: Re: Chapter Edits

Hi Lisa,

Attached is the chapter with edits. Let me know if you have a few minutes so that I can call you and talk briefly about the edits. Here are my edits as well as those from Office of Air.

Also this copy of the document contains the edits compared with the version that was reviewed by Kopocis.

Thank You

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW

Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

From: Christ, Lisa
Sent: Wednesday, August 26, 2015 10:49 AM
To: Hernandez-Quinones, Samuel
Subject: RE: Chapter Edits

Hi Sam,

Are you working with the latest version? I see Sara sent something else late yesterday that includes additional comments from Alan. Please verify that we're all working from the same version. I would prefer to look at all edits at one time to avoid the back and forth we've had previously.

Thanks-

Lisa

From: Hernandez-Quinones, Samuel
Sent: Wednesday, August 26, 2015 10:34 AM
To: Christ, Lisa
Subject: Chapter Edits

Hi Lisa,

I will send the edited chapter with accepted/rejected edits to you shortly.

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

To: DeCair, Sara[DeCair.Sara@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; Nesky, Anthony[Nesky.Tony@epa.gov]
Cc: Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]
From: Christ, Lisa
Sent: Fri 8/21/2015 4:54:08 PM
Subject: RE: Updated Q&A
[QA Document 8-18-2015 \(3\).docx](#)

Thanks All –

A few edits on the revised Q&A...

Lisa

From: DeCair, Sara
Sent: Tuesday, August 18, 2015 5:15 PM
To: Hernandez-Quinones, Samuel; Ellis, Jerry; Wieder, Jessica; Nesky, Anthony
Cc: Veal, Lee; Perrin, Alan; Christ, Lisa
Subject: Updated Q&A

I worked with Mike Noska and Bill Cunningham at FDA to edit Questions 5&6, and changed the approach on lucky #13. Please see attached redline for the changes. Some of this language might also serve well in our Comms materials, which are being finished up this week. (Thank you all!)

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

To: Galada, Heather[Galada.Heather@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
Cc: Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Thur 8/20/2015 12:03:47 PM
Subject: RE: Update on PAGs for Peter
[OSWER overarching comments on draft water PAG with OW OAR responses \(3\).docx](#)

Heather-

Attached is the document outlining OSWER's overarching concerns regarding the DW PAG and the outcome of the discussion we had the BC level. Please provide the attached to Peter in preparation for the Monday call with OWSER ODs. If our response changes based on the call Monday, we can update it before the Tuesday meeting with Ken. Let me know if you have questions or concerns.

Thanks-

Lisa

From: Galada, Heather
Sent: Wednesday, August 19, 2015 6:16 PM
To: Hernandez-Quinones, Samuel
Cc: Christ, Lisa
Subject: Re: Update on PAGs for Peter

Hi Sam,

He's meeting with him Tuesday. I can just put a bullet in to remind him to talk about whatever happens at Monday's meeting!

Thanks!

Heather

Sent from my iPhone

On Aug 19, 2015, at 5:43 PM, Hernandez-Quinones, Samuel <Hernandez.Samuel@epa.gov> wrote:

Hi Heather,

Do you know when Dr. Grevatt is meeting with Kopocis?

We will be having a meeting with OSWER on Monday and I think the outcome of that meeting should dictate the items to be included for the Kopocis meeting.

We can certainly provide some bullets, but we are at a stage on the OSWER review that is critical to determine the next steps for the PAGs.

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

From: Galada, Heather

Sent: Wednesday, August 19, 2015 5:24 PM
To: Christ, Lisa; Hernandez-Quinones, Samuel
Subject: Update on PAGs for Peter

Hi Lisa and Sam,

Ashley asked me to put together some updated for Peter to talk to Ken about early next week. I'm out of the office tomorrow and Friday, so I'm working on putting everything together today (and will probably finish it up tomorrow morning or Friday.) Could you please provide me with a few bullets on the Drinking Water Protective Action Guidelines?

Thanks,

Heather

Heather C. Galada, MPH CPH

OGWDW Acting Communications Director

US Environmental Protection Agency

Office of Ground Water & Drinking Water

1200 Pennsylvania Avenue, NW

Washington, DC 20460

202.564.5248

To: Veal, Lee[Veal.Lee@epa.gov]
From: Christ, Lisa
Sent: Wed 8/19/2015 9:03:16 PM
Subject: RE: Updated document

Hi Lee,

Thanks for checking with OP on process.

Ex. 5 - Deliberative Process

From: Veal, Lee
Sent: Wednesday, August 19, 2015 11:25 AM
To: Christ, Lisa
Subject: Updated document

Lisa,

After checking in with our new contact in the Office of Policy, we understand that they do not circulate the documents again for internal review. Therefore, I adjusted the language to tell OSWER that will give them a copy of the full manual as it is prepared for submission to the Office of Policy.

With respect to the discussion of cumulative risk, please advise if you think that we can handle this discussion in the communications materials. After examining this with our communications staff, we thought this may be the most productive way of addressing the question. If you or Peter think that we need to discuss it directly in the manual, please do say so.

Thanks

Lee

Lee Ann B. Veal

Director, Center for Radiological Emergency Management

Radiation Protection Division

Office of Radiation and Indoor Air

Office: 202-343-9448

Cell: 202-617-4322

www.epa.gov/radiation

To: Veal, Lee[Veal.Lee@epa.gov]
From: Christ, Lisa
Sent: Tue 8/18/2015 7:59:13 PM
Subject: Outcome of Meeting with OSWER on DW PAG
[OSWER overarching comments on draft water PAG with OW OAR responses.docx](#)

Hi Lee,

I added our response to the OSWER overarching comments based on our meeting last week. Please make sure my notes agree with your notes/recollection of the discussion. Feel free to modify as needed.

Thanks-

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW  
Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M

**To:** Grevatt, Peter[Grevatt.Peter@epa.gov]  
**Cc:** Burneson, Eric[burneson.eric@epa.gov]; Oshida, Phil[oshida.phil@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Tue 8/11/2015 11:42:09 AM  
**Subject:** OSWER PAG comments  
[draft OSWER Comments on draft water PAG 080315.docx](#)

Peter,

Attached is the overarching comments provided by OSWER. We intend to discuss these comments and our recommendations for addressing them. We don't believe any significant changes/re-writing will be necessary.

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]
From: Christ, Lisa
Sent: Wed 8/5/2015 12:05:24 PM
Subject: FW: OSWER comments on the draft Protective Action Guide for Drinking Water
[draft OSWER Comments on draft water PAG 080315.docx](#)
[Draft Protective Action Guide 6-16-2015 OGWDW OSWER Comments 080315.docx](#)

We're meeting about the comments today to see what we can address. We should meet once we've all had a chance to look through the comments to coordinate revisions.

From: Grevatt, Peter
Sent: Monday, August 03, 2015 4:12 PM
To: Burneson, Eric; Oshida, Phil; Christ, Lisa
Cc: Clark, Becki; Greene, Ashley
Subject: FW: OSWER comments on the draft Protective Action Guide for Drinking Water

Please see attached comments from OSWER on the draft PAG document. Note the request for a second review prior to submitting to OMB. I'll be interested to get your take on the implications of this as soon as you have an opportunity to review. Thanks, P.G.

From: Cogliano, Gerain
Sent: Monday, August 03, 2015 3:33 PM
To: Grevatt, Peter; Flynn, Mike
Cc: Stanislaus, Mathy; Breen, Barry; Natarajan, Nitin; Brooks, Becky; Hilosky, Nick; Akinnusotu, Bunmi; Simon, Nigel; Hostage, Barbara; Raffaele, Kathleen; Foster, Stiven; Woolford, James; Stalcup, Dana; Scozzafava, MichaelE; Cheatham, Reggie; Tulis, Dana; Farrar, Wanda; Evalenko, Sandy
Subject: OSWER comments on the draft Protective Action Guide for Drinking Water

Peter and Mike,

Thank you for providing OSWER the opportunity to review the draft Protective Action Guide (PAG) for drinking water. We are providing some overarching comments (see the first attachment), as well as detailed comments on the PAG (see the second attachment). OSWER will

be happy to meet to discuss our comments/concerns further.

We request the opportunity to review the revised PAG prior to both OMB submission and finalization.

If you have any questions, please contact either Barbara Hostage, Kathleen Raffaele, or myself.

Thanks again,

Gerain Cogliano

OSWER's Regulatory Steering Committee Representative

Policy and Regulatory Management Team Leader
Policy Analysis and Regulatory Management Staff (PARMS)
Office of Program Management (OPM)
Office of Solid Waste and Emergency Response (OSWER)

EPA West Room 4130
Phone Number: 202-566-1929
Fax Number: 202-566-1934
Mail Code: 5103T
cogliano.gerain@epa.gov

For ADP information:
<http://intranet.epa.gov/adplibrary>
<http://intranet.epa.gov/oswer/policy/index.htm>

To: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Tue 8/4/2015 11:58:07 AM
Subject: FW: OSWER comments on the draft Protective Action Guide for Drinking Water
[draft OSWER Comments on draft water PAG 080315.docx](#)
[Draft Protective Action Guide 6-16-2015 OGWDW OSWER Comments 080315.docx](#)

Let's meet to discuss OSWER comments.

From: Grevatt, Peter
Sent: Monday, August 03, 2015 4:12 PM
To: Burneson, Eric; Oshida, Phil; Christ, Lisa
Cc: Clark, Becki; Greene, Ashley
Subject: FW: OSWER comments on the draft Protective Action Guide for Drinking Water

Please see attached comments from OSWER on the draft PAG document. Note the request for a second review prior to submitting to OMB. I'll be interested to get your take on the implications of this as soon as you have an opportunity to review. Thanks, P.G.

From: Cogliano, Gerain
Sent: Monday, August 03, 2015 3:33 PM
To: Grevatt, Peter; Flynn, Mike
Cc: Stanislaus, Mathy; Breen, Barry; Natarajan, Nitin; Brooks, Becky; Hilosky, Nick; Akinnusotu, Bunmi; Simon, Nigel; Hostage, Barbara; Raffaele, Kathleen; Foster, Stiven; Woolford, James; Stalcup, Dana; Scozzafava, MichaelE; Cheatham, Reggie; Tulis, Dana; Farrar, Wanda; Evalenko, Sandy
Subject: OSWER comments on the draft Protective Action Guide for Drinking Water

Peter and Mike,

Thank you for providing OSWER the opportunity to review the draft Protective Action Guide (PAG) for drinking water. We are providing some overarching comments (see the first attachment), as well as detailed comments on the PAG (see the second attachment). OSWER will be happy to meet to discuss our comments/concerns further.

We request the opportunity to review the revised PAG prior to both OMB submission and finalization.

If you have any questions, please contact either Barbara Hostage, Kathleen Raffaele, or myself.

Thanks again,

Gerain Cogliano

OSWER's Regulatory Steering Committee Representative

Policy and Regulatory Management Team Leader
Policy Analysis and Regulatory Management Staff (PARMS)
Office of Program Management (OPM)
Office of Solid Waste and Emergency Response (OSWER)

EPA West Room 4130
Phone Number: 202-566-1929
Fax Number: 202-566-1934
Mail Code: 5103T
cogliano.gerain@epa.gov

For ADP information:
<http://intranet.epa.gov/adplibrary>
<http://intranet.epa.gov/oswer/policy/index.htm>

To: Veal, Lee[Veal.Lee@epa.gov]; Edwards, Jonathan[Edwards.Jonathan@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]
Cc: Wieder, Jessica[Wieder.Jessica@epa.gov]; Boyd, Mike[Boyd.Mike@epa.gov]
From: Christ, Lisa
Sent: Tue 7/7/2015 4:56:54 PM
Subject: RE: REVISED : Draft Drinking Water PAG for OSWER review

Looks good

From: Veal, Lee
Sent: Tuesday, July 07, 2015 12:55 PM
To: Edwards, Jonathan; DeCair, Sara; Perrin, Alan
Cc: Christ, Lisa; Wieder, Jessica; Boyd, Mike
Subject: REVISED : Draft Drinking Water PAG for OSWER review

All,

Please take a look at these changes.

Answers to Jim's Questions:

Ex. 5 - Deliberative Process

First, it is important to note that the NPDWR for radionuclides still applies to the drinking water utilities. Any exceedance of the maximum contaminant level, even in an emergency, is a violation and utilities must return to compliance with the NPDWR MCLs as soon as practical. In

addition, the utility must notify customers that they are in violation. Those provisions are not impacted by establishing a drinking water PAG.

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Begin forwarded message:

From: "Woolford, James" <Woolford.James@epa.gov>

Date: July 6, 2015 at 5:56:11 PM EDT

To: "Flynn, Mike" <Flynn.Mike@epa.gov>

Cc: "Grevatt, Peter" <Grevatt.Peter@epa.gov>

Subject: RE: Draft Drinking Water PAG for OSWER review

Was just reading this over. Sorry I missed the brief.

Ex. 5 - Deliberative Process

Thanks

Jim Woolford, Director

Office of Superfund Remediation and Technology Innovation

Office of Solid Waste and Emergency Response

US Environmental Protection Agency

1200 Penn. Ave., NW

Washington, DC 20460

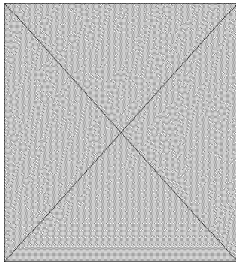
(Mail Code 5201-P)

Phone: (703) 603 8960— Main Office Line

Physically located at:

Room 5622

One Potomac Yard (South)
2777 S. Crystal Dr.
Arlington, VA 22202



From: Flynn, Mike

Sent: Wednesday, June 24, 2015 5:30 PM

To: Cheatham, Reggie; Woolford, James

Cc: Grevatt, Peter; Tulis, Dana; Gardner, Monica; Fitz-James, Schatzi;
Kudarauskas, Paul; DeCair, Sara; Hernandez-Quinones, Samuel; Edwards,
Jonathan; Burneson, Eric; Perrin, Alan; Christ, Lisa

Subject: Draft Drinking Water PAG for OSWER review

Importance: High

Reggie and Jim,

Peter and I appreciate your time and support on the drinking water PAG proposal and, as you know, we're anxious to get this to the Office of Policy soon. We hope yesterday's briefing and discussion with your staff will enable you to get feedback to us on this proposal by July 14. I've attached the draft PAG chapter for your review.

OW and OAR staff are available to discuss any of the proposal details as needed and when it's convenient for you. Please contact Sam Hernandez at (202) 564-1735 or Sara DeCair at (202) 343-9108 with any questions or to set up a meeting; please direct any comments or suggestions you have on the PAG chapter to them as well.

Again, thank you in advance for your support and input, and don't hesitate to call Peter or me if you have questions.

Thanks,

Mike

<image001.png>

To: Ohanian, Edward[Ohanian.Edward@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]
From: Christ, Lisa
Sent: Mon 6/29/2015 12:15:45 PM
Subject: RE: Draft Drinking Water PAG for OSWER review - confidential

Ed,

OGWDW and OAR briefed OSWER managers on the PAG last Tuesday. At that time we discussed review by OSWER of the draft PAG. Below is a list of attendees.

Flynn, Mike <Flynn.Mike@epa.gov>; Grevatt, Peter <Grevatt.Peter@epa.gov>; Woolford, James <Woolford.James@epa.gov>; Cheatham, Reggie <cheatham.reggie@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Edwards, Jonathan <Edwards.Jonathan@epa.gov>; Hernandez-Quinones, Samuel <Hernandez.Samuel@epa.gov>; Ellis, Jerry <Ellis.Jerry@epa.gov>; Burneson, Eric <Burneson.Eric@epa.gov>; Tulis, Dana Tulis.Dana@epa.gov

Stalcup, Dana <Stalcup.Dana@epa.gov>; Scozzafava, MichaelE <Scozzafava.MichaelE@epa.gov>; Fitz-James, Schatzi <Fitz-James.Schatzi@epa.gov>; Gardner, Monica <Gardner.Monica@epa.gov>; Kudarauskas, Paul <Kudarauskas.Paul@epa.gov>; Cardarelli, John Cardarelli.John@epa.gov

From: Ohanian, Edward
Sent: Friday, June 26, 2015 4:41 PM
To: DeCair, Sara; Christ, Lisa
Subject: Re: Draft Drinking Water PAG for OSWER review - confidential

Hi Sara and Lisa,

Heads up. Your draft PAG created some excitement within OSWER and OAR. See attached from OSWER. It may be a good idea to schedule a briefing ASAP since they are planning to brief their ODs and DAAs. Let me know how I can help by contacting my counterpart program office coordinators. Be well, Ed

Edward V. Ohanian, Ph.D.

Associate Director for Science

Office of Water (MC: 4301)

USEPA

(202) 566-1117 (Voice)

(202) 566-0441(Fax)

On Jun 25, 2015, at 8:00 AM, Raffaele, Kathleen <raffaele.kathleen@epa.gov> wrote:

Carl and Ed,

Did you know about this? I would like to talk with you about it at our meeting this afternoon.

- proposes a two-tier approach for PAGs during the intermediate phase of a response to a radiation incident
 - o PAG of 500 mrem for adults defined as aged 15 and older
 - o PAG of 100 mrem for more sensitive populations comprised of pregnant women, children younger than 15, and nursing mothers.

Thanks!

Kathleen

Kathleen Raffaele, Ph.D.

Senior Science Advisor
Policy Analysis and Regulatory Management Staff
Office of Solid Waste and Emergency Response (OSWER)
U.S. EPA

Telephone (202) 566-0301

Mailcode 5103T

<Draft Protective Action Guide 6-16-2015 OGWDW.DOCX>

To: Ohanian, Edward[Ohanian.Edward@epa.gov]
From: Christ, Lisa
Sent: Mon 6/29/2015 12:23:23 PM
Subject: RE: Draft Drinking Water PAG for OSWER review - confidential

OAR is working with OW on the PAG and have already reviewed the PAG.

From: Ohanian, Edward
Sent: Monday, June 29, 2015 8:21 AM
To: Christ, Lisa; DeCair, Sara
Subject: RE: Draft Drinking Water PAG for OSWER review - confidential

Hi Lisa,

Thank you for the clarification. Per your email, both OAR and OSWER reviews are in progress.
Correct? Thx, Ed

Edward V. Ohanian, Ph.D.

Associate Director for Science

Office of Water (MC: 4301T)

(202) 566-1117 (Voice)

(202) 566-0441(Fax)

Mailing Address:

U.S. Environmental Protection Agency

Rm: 5231P/Q WJC East (MC: 4301T)

1200 Pennsylvania Avenue, NW

Washington, DC 20460

Address for Visitors and Deliveries:

1201 Constitution Avenue, NW

WJC East, 5th Floor, Rm: 5231P/Q

Washington, DC 20004

From: Christ, Lisa

Sent: Monday, June 29, 2015 8:16 AM

To: Ohanian, Edward; DeCair, Sara

Subject: RE: Draft Drinking Water PAG for OSWER review - confidential

Ed,

OGWDW and OAR briefed OSWER managers on the PAG last Tuesday. At that time we discussed review by OSWER of the draft PAG. Below is a list of attendees.

Flynn, Mike <Flynn.Mike@epa.gov>; Grevatt, Peter <Grevatt.Peter@epa.gov>; Woolford, James <Woolford.James@epa.gov>; Cheatham, Reggie <cheatham.reggie@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Edwards, Jonathan <Edwards.Jonathan@epa.gov>; Hernandez-Quinones, Samuel <Hernandez.Samuel@epa.gov>; Ellis, Jerry <Ellis.Jerry@epa.gov>; Burneson, Eric <Burneson.Eric@epa.gov>; Tulis, Dana <Tulis.Dana@epa.gov>

Stalcup, Dana <Stalcup.Dana@epa.gov>; Scozzafava, MichaelE <Scozzafava.MichaelE@epa.gov>; Fitz-James, Schatzi <Fitz-James.Schatzi@epa.gov>; Gardner, Monica <Gardner.Monica@epa.gov>; Kudarauskas, Paul <Kudarauskas.Paul@epa.gov>; Cardarelli, John <Cardarelli.John@epa.gov>

From: Ohanian, Edward

Sent: Friday, June 26, 2015 4:41 PM

To: DeCair, Sara; Christ, Lisa

Subject: Re: Draft Drinking Water PAG for OSWER review - confidential

Hi Sara and Lisa,

Heads up. Your draft PAG created some excitement within OSWER and OAR. See attached from OSWER. It may be a good idea to schedule a briefing ASAP since they are planning to brief their ODs and DAAs. Let me know how I can help by contacting my counterpart program office coordinators. Be well, Ed

Edward V. Ohanian, Ph.D.

Associate Director for Science

Office of Water (MC: 4301)

USEPA

(202) 566-1117 (Voice)

(202) 566-0441(Fax)

On Jun 25, 2015, at 8:00 AM, Raffaele, Kathleen <raffaele.kathleen@epa.gov> wrote:

Carl and Ed,

Did you know about this? I would like to talk with you about it at our meeting this afternoon.

- proposes a two-tier approach for PAGs during the intermediate phase of a response to a radiation incident
 - o PAG of 500 mrem for adults defined as aged 15 and older
 - o PAG of 100 mrem for more sensitive populations comprised of pregnant women, children younger than 15, and nursing mothers.

Thanks!

Kathleen

Kathleen Raffaele, Ph.D.

Senior Science Advisor
Policy Analysis and Regulatory Management Staff
Office of Solid Waste and Emergency Response (OSWER)
U.S. EPA

Telephone (202) 566-0301

Mailcode 5103T

<Draft Protective Action Guide 6-16-2015 OGWDW.DOCX>

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Fri 6/26/2015 7:12:06 PM
Subject: RE: Draft Drinking Water PAG proposal in review now

thanks

From: Hernandez-Quinones, Samuel
Sent: Friday, June 26, 2015 2:34 PM
To: Christ, Lisa
Subject: Fw: Draft Drinking Water PAG proposal in review now

FYI.

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

From: DeCair, Sara
Sent: Friday, June 26, 2015 2:05 PM
To: Mazza, Carl; Ohanian, Edward; Raffaele, Kathleen; Foster, Stiven
Cc: Veal, Lee; Shoaff, John; Perrin, Alan; Hernandez-Quinones, Samuel; Royce, Christopher; Ellis, Jerry
Subject: Draft Drinking Water PAG proposal in review now

Good afternoon Carl,

Thank you for helping us share context for this proposal across offices. See attached our draft Action Memo for a little more detail and please advise if a briefing would be helpful. OGWDW and ORIA are making key staffers available at any time during these internal reviews, in particular myself, Sam Hernandez and Lisa Christ. I'm glad to find a mutually agreeable time if you tell me who should be invited.

OGWDW and ORIA have collaborated on this proposal for short term drinking water guidance for radiological emergencies (a drinking water PAG), which is a gap identified by commenters on the Agency's 2013 revision of the Protective Action Guides and Planning Guidance for Radiological Incidents ("PAG Manual"). The purpose of the PAG Manual is to help federal, state, and local authorities make decisions to protect the public during radiological emergencies. This drinking water proposal is to be announced in the Federal Register for public comments prior to inclusion in the full PAG Manual.

OGC has completed their reviews, and OHS and OSWER (OEM and OSRTI) are currently reviewing the proposal. We briefed Dana Tulis and Monica Gardner the other day, along with key staff in their offices. The interagency group that develops the PAG Manual is supportive of the approach. We're following a similar process path as we used with the 2013 PAG Manual, including reviews by offices involved in radiation protection and emergency response (OSWER, OHS, OW) then facilitation by OP and interagency review by OMB.

Thank you and I hope you have a lovely weekend,

Sara

202-343-9108

To: Oshida, Phil[Oshida.Phil@epa.gov]; Carroll, Gregory[Carroll.Gregory@epa.gov]; Hautman, Dan[Hautman.Dan@epa.gov]; Huff, Lisa[Huff.Lisa@epa.gov]; Rodgers-Jenkins, Crystal[Rodgers-Jenkins.Crystal@epa.gov]; Albert, Ryan[Albert.Ryan@epa.gov]
Cc: Burneson, Eric[Burneson.Eric@epa.gov]
From: Christ, Lisa
Sent: Fri 6/26/2015 7:51:57 PM
Subject: RE: For review and input - need info by COB today
[Copy of Regulatory Milestones 6-25-15 lc.xlsx](#)

My comments are attached.

Thanks

Lisa

From: Oshida, Phil
Sent: Thursday, June 25, 2015 2:47 PM
To: Carroll, Gregory; Christ, Lisa; Hautman, Dan; Huff, Lisa; Rodgers-Jenkins, Crystal; Albert, Ryan
Cc: Burneson, Eric
Subject: For review and input - need info by COB today

June 25, 2015

SRMD Management Team,

In the meeting I had with Peter, Becki, and Ashley this morning, Peter said that he had a one-on-one meeting with Ken Kopocis tomorrow. In this meeting with Ken, Peter wants to provide information that gives Ken a solid idea of what regulatory-related issues will be coming Ken's way during the remainder of 2015 and 2016.

I was asked to produce a simple table that portrayed our major projects and their (conservative) milestone dates. Peter provided me with a rough template and I have proceeded to fill in the information.

Please review the draft table and make changes and revisions. In places where you have told me "Fall 2015", I have substituted December 2015 (an example). Where you would like to change the date, please go ahead.

I need your input by COB today as I have to provide this to Peter by 10:00 AM tomorrow.

Thanks.

-Phil-

To: Grevatt, Peter[Grevatt.Peter@epa.gov]
From: Christ, Lisa
Sent: Tue 6/23/2015 9:02:05 PM
Subject: FW: Clean Version of PAG Document (6/16/15)
Draft Protective Action Guide 6-16-15 OGWDW.docx

Peter –

Attached is the draft drinking water PAG proposal for your (re)review.

Lisa

From: Christ, Lisa
Sent: Wednesday, June 17, 2015 1:52 PM
To: DeCair, Sara; Veal, Lee; Perrin, Alan
Cc: Hernandez-Quinones, Samuel; Ellis, Jerry
Subject: FW: Clean Version of PAG Document (6/16/15)

All-

Attached is the revised proposal which incorporates Ken's comments. At this point we've obtained review by the AA for OW and OGC.

Thanks-

Lisa

From: Hernandez-Quinones, Samuel
Sent: Tuesday, June 16, 2015 1:19 PM
To: Christ, Lisa
Subject: Clean Version of PAG Document (6/16/15)

Attached

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

To: Burneson, Eric[Burneson.Eric@epa.gov]
From: Christ, Lisa
Sent: Mon 6/22/2015 2:56:02 PM
Subject: RE: draft reply to Ken's questions PAG vs cyanotoxin HA

Hi Eric –

Your revision below is accurate. I believe an email reply (from Peter or you) to Ken's question is all that is necessary. Ken's comments on the PAG itself were minimal.

Lisa

From: Burneson, Eric
Sent: Thursday, June 18, 2015 3:27 PM
To: Christ, Lisa
Subject: RE: draft reply to Ken's questions PAG vs cyanotoxin HA

Lisa:

First can you let me know how we plan to get back to Ken? Do we have to resubmit the PAGs document to Ken or are we transmitting a note to him in response to his comment without actually giving him another opportunity to revise. Please run this explanation by our technical folks to see if it is still accurate.

Second, we should look at this as an opportunity to craft a public Q&A on the document. I think our response is still a little too technical.

Q: Did EPA use the same methodology to derive its childrens values for a Radionuclides and for cyanotoxins?

A: No, Radionuclides are different from most other toxins in that they may cause damage (cancer) by delivering a dose of radiation when they decay in the body as opposed to chemical

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From: Christ, Lisa
Sent: Monday, June 15, 2015 2:10 PM
To: Burneson, Eric
Subject: FW: draft reply to Ken's questions PAG vs cyanotoxin HA

Eric-I worked with SRRB to prepare the below explanation. Let me know if you have comments, questions or concerns

Lisa

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**Sent:** Monday, June 15, 2015 1:03 PM  
**To:** Christ, Lisa  
**Cc:** Holsinger, Hannah  
**Subject:** FW: draft reply to Ken's questions

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Ryan

Ryan Albert, Ph.D.

Associate Chief

Standards and Risk Reduction Branch

Office of Ground Water and Drinking Water

United States Environmental Protection Agency

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**Sent:** Thursday, June 11, 2015 1:55 PM

**To:** Albert, Ryan

**Subject:** RE: draft reply to Ken's questions

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Hannah

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**Sent:** Thursday, June 11, 2015 9:11 AM

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**Subject:** FW: draft reply to Ken's questions

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Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]
From: Christ, Lisa
Sent: Thur 6/18/2015 8:48:47 PM
Subject: FW: To provide to ODs: Fri. 6/12 Water PAG briefing mat'ls
[Water PAG briefing for ODs 6-23-2015.docx](#)

Hi Sam,

The briefing paper needs to go to Ashley Green, Paula Mason and Doris Williams by 4pm Wednesday for Peter. Please work with ORIA to make sure we get the final materials to Peter Monday.

Thanks-

Lisa

From: Christ, Lisa
Sent: Thursday, June 18, 2015 4:45 PM
To: DeCair, Sara; Veal, Lee; Hernandez-Quinones, Samuel; Ellis, Jerry; Edwards, Jonathan; Perrin, Alan
Subject: RE: To provide to ODs: Fri. 6/12 Water PAG briefing mat'ls

Hello –

I made the edits suggested by Peter and Mike during the pre-brief last Friday. Also, I suggest Sara cover the parts of the briefing highlighted yellow and Sam those highlighted blue. Let me know if anyone has questions or concerns.

Lisa

From: DeCair, Sara
Sent: Wednesday, June 10, 2015 4:43 PM
To: Veal, Lee; Christ, Lisa; Hernandez-Quinones, Samuel; Ellis, Jerry; Edwards, Jonathan; Perrin, Alan
Subject: To provide to ODs: Fri. 6/12 Water PAG briefing mat'ls

All;

Please provide these materials to Office Directors Mike Flynn and Peter Grevatt ASAP in preparation for Friday's 11 am pre-brief. I just did a little formatting improvement on the briefing itself, and the internal Q&A is unchanged.

I would like to open the briefing, then hand it to Sam for Background on SDWA and Options Considered sections, then I will go through Proposed Approach to the end. I plan to note any suggestions they have on the material and will revise the briefing for the meeting with OSWER on June 23.

See you all Friday!

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

Room 1416 B in WJC West

To: Burneson, Eric[Burneson.Eric@epa.gov]
From: Christ, Lisa
Sent: Thur 6/18/2015 8:17:35 PM
Subject: RE: draft reply to Ken's questions PAG vs cyanotoxin HA

I like your answer. I'm having Sam do a quick review as requested of your reply and then we'll be ready to respond to Ken.

It's all good

From: Burneson, Eric
Sent: Thursday, June 18, 2015 3:59 PM
To: Christ, Lisa
Subject: RE: draft reply to Ken's questions PAG vs cyanotoxin HA

Did you see that I drafted a less technical Q&A, or are you indirectly telling me you don't like what I wrote?

From: Christ, Lisa
Sent: Thursday, June 18, 2015 3:35 PM
To: Burneson, Eric
Subject: RE: draft reply to Ken's questions PAG vs cyanotoxin HA

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Mail Code: 4607M

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From: Christ, Lisa
Sent: Thur 6/18/2015 7:35:48 PM
Subject: FW: draft reply to Ken's questions PAG vs cyanotoxin HA

Hi Sam,

Please review Eric's response to Ken's questions for accuracy.

Thanks-

Lisa

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**To:** Albert, Ryan  
**Subject:** RE: draft reply to Ken's questions

For the microcystins and cylindrospermopsin Health Advisories, EPA used the Exposure Factors Handbook (2011) to obtain values for drinking water ingestion rate and corresponding body weight. The estimated 90th percentile of community water ingestion for the general population (males and females of all ages) has been used as the default value for water ingestion. Using the ingestion rates for each age-group (from the Exposure Factors Handbook), EPA estimated Ten-day HA values for microcystins for each age group to demonstrate the variability due to body weight and drinking water intake by age. EPA decided to apply the Ten-day HA value calculated for infants over the first year of life to all bottle-fed infants and young children of pre-school age because these age groups have higher intake per body weight relative to adults. The Health Advisory is for the ingestion of drinking water for acute health endpoints. Chronic and cancer endpoints did not have sufficient information to allow for Health Advisories at those levels.

Thanks!

Hannah

**From:** Albert, Ryan  
**Sent:** Thursday, June 11, 2015 9:11 AM  
**To:** Holsinger, Hannah  
**Subject:** FW: draft reply to Ken's questions

**From:** Christ, Lisa  
**Sent:** Thursday, June 11, 2015 9:10 AM  
**To:** Albert, Ryan  
**Subject:** draft reply to Ken's questions



Ryan – Can you please help me explain the consumption rate you used for cyano toxins to determine the age for the lower level HA? See below

Ken,

In your comments on the drinking water radiation PAG you asked what consumption rate used and how it compared to cyano toxins.

For the PAG OGWDW used mean drinking water ingestion rates from EPA's Federal Guidance Report 13. Cancer Risk Coefficients for Environmental Exposures to Radionuclides (EPA 402-C-99-001, Rev. 1). The ingestion rates presented in FRG-13 were specifically designed with corresponding age ranges to be used in conjunction with other FGR-13 data (e.g., dose conversion factors).

For the cyano toxins health advisory, OGWDW used drinking water consumption rates from the Exposures Factors Handbook. Only consumption rates were used to identify to determine ...???

~~~~~  
Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]
Cc: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Wed 6/17/2015 5:52:17 PM
Subject: FW: Clean Version of PAG Document (6/16/15)
Draft Protective Action Guide 6-16-15 OGWDW.docx

All-

Attached is the revised proposal which incorporates Ken's comments. At this point we've obtained review by the AA for OW and OGC.

Thanks-

Lisa

From: Hernandez-Quinones, Samuel
Sent: Tuesday, June 16, 2015 1:19 PM
To: Christ, Lisa
Subject: Clean Version of PAG Document (6/16/15)

Attached

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

To: Greene, Ashley[Greene.Ashley@epa.gov]
From: Christ, Lisa
Sent: Mon 6/1/2015 4:04:05 PM
Subject: FW: PAG chapter w/OGC comments incorporated.
[Draft Protective Action Guide 6-1-15 OGWDW.docx](#)
[V4 -KKopocis Pre-Brief Materials DW PAG egb.docx](#)
[OW-OAR PAG brief final.docx](#)

Hi Ashley,

Peter provided comment Friday, which is incorporated in the attached document. The next step is to get Ken's review/sign-off so we can prepare the proposal for OMB review. Ideally if Ken could review by June 12, Peter is pre-meeting with Mike Flynn (OAR) to discuss OSWER, OEM and OMB review. Below is a draft email for Peter's use. Let me know if you need anything else from us.

Thanks-

Lisa

From: Hernandez-Quinones, Samuel
Sent: Monday, June 01, 2015 11:38 AM
To: Christ, Lisa
Subject: Re: PAG chapter w/OGC comments incorporated.

Hi Lisa,

please find the draft email language and requested files below.

Thanks

Sam

=====

Ken,

Attached for your review is a draft proposal for a Radiation Protective Action Guide (PAG) for Drinking Water. My staff and I briefed you on October 28, (briefing attached) in preparation for a briefing with the Deputy Administrator, Stan Meiburg, on November 20, 2014 (also attached).

Ex. 5 - Deliberative Process

Note: Our schedule has changed since the briefings last fall.

The attached proposal incorporates comments from the Deputy Administrator and OW's OGC. Let me know if you'd like a briefing or additional information.

=====

Samuel Hernández Quiñones, P.E.
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Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

From: Christ, Lisa
Sent: Monday, June 1, 2015 10:25 AM
To: Hernandez-Quinones, Samuel
Subject: RE: PAG chapter w/OGC comments incorporated.

Thanks Sam -- Please prepare a draft email that Peter could send to Ken. It should include the revised chapter

100-based as of
Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Thanks-

]Lisa

From: Hernandez-Quinones, Samuel
Sent: Monday, June 01, 2015 10:17 AM
To: Christ, Lisa
Subject: Re: PAG chapter w/OGC comments incorporated.

I think I do. I will look for it and send it to you also.

Sam

=====

Samuel Hernández Quiñones, P.E.
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202-564-1735

"USEPA Protecting Human Health and the Environment"

From: Christ, Lisa
Sent: Monday, June 1, 2015 10:15 AM
To: Hernandez-Quinones, Samuel
Subject: RE: PAG chapter w/OGC comments incorporated.

I wanted to include a copy of the Stan Mieburg briefing with the document and a cover note. Do you have access to the briefing document?

From: Hernandez-Quinones, Samuel
Sent: Monday, June 01, 2015 10:13 AM
To: Christ, Lisa
Subject: Re: PAG chapter w/OGC comments incorporated.

Ok, I was planning on sending it to Ashley and ask her about the best way to get the document to Mr. Kopocis. But I will send it to you then.

Thanks

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

From: Christ, Lisa
Sent: Monday, June 1, 2015 10:10 AM
To: Hernandez-Quinones, Samuel
Cc: Ellis, Jerry
Subject: RE: PAG chapter w/OGC comments incorporated.

Hi Sam,

Please send the revised document to me. I would like to get this to Ken today so he can begin

his review.

Thanks-

Lisa

From: Christ, Lisa
Sent: Friday, May 29, 2015 9:11 AM
To: Hernandez-Quinones, Samuel
Cc: Ellis, Jerry
Subject: FW: PAG chapter w/OGC comments incorporated.

Hi Sam,

Attached are Peter's comments. I added my notes in the comment bubbles. Please accept all changes. We can respond to his questions during the pre-briefing on 6/12.

I'd like to have the document ready to go to Ken Monday.

Thanks-

Lisa

From: Grevatt, Peter
Sent: Friday, May 29, 2015 8:24 AM
To: Christ, Lisa
Cc: Greene, Ashley; Burneson, Eric; Clark, Becki
Subject: RE: PAG chapter w/OGC comments incorporated.

Lisa, please see my comments on the draft PAG document in the attachment. Thanks to you and your staff for another great job! I know that Mike is eager to press forward with this document. Please let me know if you have any questions on my comments and please also let me know if there are ways that I can help to expedite our next steps. Thanks, P.G.

From: Christ, Lisa
Sent: Thursday, May 28, 2015 5:33 PM
To: Grevatt, Peter
Cc: Greene, Ashley
Subject: FW: PAG chapter w/OGC comments incorporated.

Hi Peter –

Attached is the e-version of the radiation PAG. I appreciate the quick review.

Thanks-

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW  
Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M

**To:** Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]  
**Cc:** Ellis, Jerry[Ellis.Jerry@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Fri 5/29/2015 1:10:35 PM  
**Subject:** FW: PAG chapter w/OGC comments incorporated.  
[Draft Protective Action Guide 5-15-15 grevatt comments.docx](#)

Hi Sam,

Attached are Peter's comments. I added my notes in the comment bubbles. Please accept all changes. We can respond to his questions during the pre-briefing on 6/12.

I'd like to have the document ready to go to Ken Monday.

Thanks-

Lisa

**From:** Grevatt, Peter  
**Sent:** Friday, May 29, 2015 8:24 AM  
**To:** Christ, Lisa  
**Cc:** Greene, Ashley; Burneson, Eric; Clark, Becki  
**Subject:** RE: PAG chapter w/OGC comments incorporated.

Lisa, please see my comments on the draft PAG document in the attachment. Thanks to you and your staff for another great job! I know that Mike is eager to press forward with this document. Please let me know if you have any questions on my comments and please also let me know if there are ways that I can help to expedite our next steps. Thanks, P.G.

**From:** Christ, Lisa  
**Sent:** Thursday, May 28, 2015 5:33 PM  
**To:** Grevatt, Peter  
**Cc:** Greene, Ashley  
**Subject:** FW: PAG chapter w/OGC comments incorporated.

Hi Peter –

Attached is the e-version of the radiation PAG. I appreciate the quick review.

Thanks-

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

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fax: 202.564-3760

Mail Code: 4607M

To: Grevatt, Peter[Grevatt.Peter@epa.gov]
Cc: Greene, Ashley[Greene.Ashley@epa.gov]
From: Christ, Lisa
Sent: Thur 5/28/2015 9:33:05 PM
Subject: FW: PAG chapter w/OGC comments incorporated.
Draft Protective Action Guide 5-15-15.docx

Hi Peter –

Attached is the e-version of the radiation PAG. I appreciate the quick review.

Thanks-

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

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Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M

**To:** Fultz, Christopher[Fultz.Christopher@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Tue 5/26/2015 2:54:17 PM  
**Subject:** RE: June 2015 TAB Meeting

Thanks Chris – you may want to remove cVOCs since there's not much happening there and include research for the team round robin.

**From:** Fultz, Christopher  
**Sent:** Tuesday, May 26, 2015 10:29 AM  
**To:** Christ, Lisa  
**Subject:** June 2015 TAB Meeting

Good morning,

Ma'am, Sam agreed to do a discussion during this upcoming meeting concerning PAGS so we have a presenter. Yay! So I prepared a draft agenda with his presentation time included.

Christopher Van Fultz  
Statistician  
U.S. Environmental Protection Agency

Office of Ground Water and Drinking Water

Standards & Risk Management Division  
Targeting & Analysis Branch

1201 NW Constitution Avenue

Washington, DC 20460

[fultz.christopher@epa.gov](mailto:fultz.christopher@epa.gov)  
202-564-8907

**To:** Veal, Lee[Veal.Lee@epa.gov]  
**Cc:** DeCair, Sara[DeCair.Sara@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Thur 5/21/2015 8:54:30 PM  
**Subject:** PAG chapter w/OGC comments incorporated.  
Draft Protective Action Guide 5-15-15.docx

Ladies –

Here's the draft version Peter is reviewing.

Have a great weekend -

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

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1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Wed 5/13/2015 4:40:01 PM
Subject: PAG Q&A
Internal QandAs Drinking Water PAG 5-5-15 JLE lc.docx

thanks

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

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phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M

**To:** Ellis, Jerry[Ellis.Jerry@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Wed 5/13/2015 8:41:51 PM  
**Subject:** RE: PAG: Updated Communications Plan  
DRAFT Drinking Water PAG Comms Plan Clean 5-13-15\_lc.doc

Thanks Jerry –

It looks great. I made a few formatting edits. I think it's ready to go to ORIA.

L

**From:** Ellis, Jerry  
**Sent:** Wednesday, May 13, 2015 2:57 PM  
**To:** Christ, Lisa; Hernandez-Quinones, Samuel  
**Subject:** PAG: Updated Communications Plan

Hi Lisa and Sam:

Here is the updated document based on our conversation this morning. Thank you for the input.

---

Jerry L. Ellis, Jr.

Environmental Scientist

U.S. Environmental Protection Agency

Standards and Risk Management Division

Office of Ground Water and Drinking Water

1200 Pennsylvania Ave. (4607M), N.W.

Washington, D.C. 20460

Phone: 202-564-2766



**To:** Strong, Jamie[Strong.Jamie@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Mon 5/11/2015 8:34:35 PM  
**Subject:** drinking water radiation protective action guides (PAG)

Hi Jamie –

You may recall we met with anti-nuclear groups on April 21, to discuss their concerns which *include reducing and stopping radioactive exposures to the most vulnerable parts of our human life cycle, and preventing radionuclides from being treated as “preferred pollutants” in any EPA regulations or guidance, including the water and cleanup standards, the nuclear power fuel cycle rule, the Protective Action Guides (PAGs) and EPA’s proposed new Carbon Rule.*

OGWDW is getting close to proposing a drinking water PAG and I wanted to make sure you’re up to speed on the effort. We intend to propose a two-tier PAG; one level for pregnant moms and children 15 years old or younger and a different level for the general population. We have a rationale for selecting this 15 y/o age cut-off based on maintaining an “acceptable risk level” and identifying the age group with the most limiting corresponding drinking water concentration (0, 5, 10, 15 or adult).

I realize you are preparing to release cyano toxin health advisories that use a different age cut-off for the child vs adult value. Let me know if you’d like to discuss this more or if I can send you additional information about the PAG.

Lisa

~~~~~  
Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

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Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: Ellis, Jerry[Ellis.Jerry@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Mon 5/11/2015 4:47:57 PM
Subject: RE: Comms plan back to you
DRAFT Drinking Water PAG Communications Plan (clean) 5-4-15 JLE lc.doc

Hi Jerry –

I made a few edits too, see attached.

Lisa

From: Ellis, Jerry
Sent: Monday, May 11, 2015 12:45 PM
To: Hernandez-Quinones, Samuel; Christ, Lisa
Subject: FW: Comms plan back to you

Hi Sam and Lisa:

Sara had some add'l comments on the draft communications plan (see attached). Jessica is on vacation and Sara and I should be talking further today about their review process. Sara had mentioned moving the documents up through their management chain, and I didn't understand at what point in the process.

I set a meeting later this week to talk with you about any remaining concerns with the comm plan and internal Q&As.

Jerry L. Ellis, Jr.

Environmental Scientist

U.S. Environmental Protection Agency

Standards and Risk Management Division

Office of Ground Water and Drinking Water

1200 Pennsylvania Ave. (4607M), N.W.

Washington, D.C. 20460

Phone: 202-564-2766

From: DeCair, Sara

Sent: Monday, May 11, 2015 9:12 AM

To: Ellis, Jerry

Cc: Nesky, Anthony

Subject: Comms plan back to you

Jerry, I hope you're feeling better. Jessica and I marked up the comms plan with some things we feel pretty strongly about, but need to check with you before this is ready for management review. We'll have to get this to our Division management in order to concur.

We're hoping to brief ODs across the Agency in June, so this will have to be final for the FR package to be ready. Please let me know when you can have this back to me so we can get this up the chain. Thank you so much!!

Sara

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Wed 5/6/2015 1:55:06 PM
Subject: RE: slides for PR water symposium

Thanks for the update. We can give OGC more time for review, but I'd like to confirm a date with Paul. Maybe sometime early-mid next week?

From: Hernandez-Quinones, Samuel
Sent: Wednesday, May 06, 2015 9:30 AM
To: Christ, Lisa
Subject: RE: slides for PR water symposium

Hi Lisa,

I got a message from OGC this morning regarding the PAGs review, they are requesting additional time to complete their review. I think I can talk to you about this today before I sent a response.

The slides for the symposium have to be submitted by May 14, 2015. I think we have some time to setup a meeting this week to talk about it.

I sent the response to the hotline question. I will let you know if they have any follow-up questions.

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water

1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

From: Christ, Lisa
Sent: Wednesday, May 06, 2015 7:51 AM
To: Hernandez-Quinones, Samuel
Subject: FW: slides for PR water symposium

Hi Sam,

I'm following up on a few items. Please provide the status of OGC's review of the PAG, your presentation for the PR water symposium, and the response to the hotline on the radon question.

Thanks-

Lisa

From: Christ, Lisa
Sent: Thursday, April 30, 2015 11:07 AM
To: Hernandez-Quinones, Samuel
Subject: slides for PR water symposium

Hi Sam,

I just wanted to check in on the timing for my review of your presentation. I appreciate

you coordinating with Mike Lowy on this.

Thanks-

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

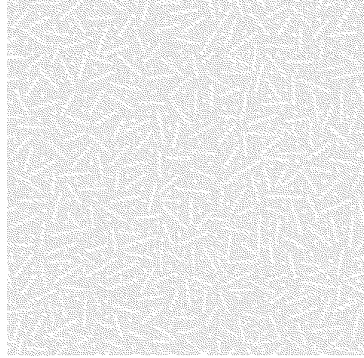
Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW  
Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M

**To:** Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Tue 5/5/2015 2:25:31 PM  
**Subject:** FW: FOR PROGRAM OFFICE CONCURRENCE: DRAFT Standard Operating Guideline for waste staging  
[WA 5-34 EPA Operational Guidelines - April 2015.docx](#)



Hi Sam & Jerry –

I've tried to get more information from Marissa on who else in OW is reviewing the document. As far as I can tell, this guidance does not contain information on the NPDWR for radionuclides or anything else about drinking water. As such, this guidance is a bit outside our expertise (disposal of radiological contaminated waste). I asked for clarification on the "statutory framework" ORD mention below, but haven't heard from Marissa. Let me know if you are willing/able to review the document in consideration of the SDWA. This should not be a priority over other work though. I'm happy to discuss if you'd like.

Thank you in advance -

Lisa

**From:** Lynch, Marissa  
**Sent:** Monday, April 27, 2015 8:38 AM  
**To:** Christ, Lisa  
**Cc:** Tidwell-Shelton, Patricia  
**Subject:** FW: FOR PROGRAM OFFICE CONCURRENCE: DRAFT Standard Operating Guideline for waste staging  
**Importance:** High

Good Morning Lisa,

It was a pleasure speaking with you earlier. Attached is the RAD document from ORD/NHSRC-Standard Operating Guideline for early phase waste staging following a radiological incident. The document provides technical information to rad incident first responders that may help them minimize difficulties in the intermediate and long-term cleanup phase of the response. The document is intended to be a compilation of best practices from a technical standpoint, without attempting to deal with the regulatory complexities. But along with that, ORD wants to ensure that they don't say anything that is contrary to the current statutory framework. This would include properly caveating recommendations and deleting explicit references to, say CERCLA for instance. The deadline to get back to ORD is May 15. I am planning on speaking with my management by May 12. Please let me know if you have any questions or concerns. We appreciate you taking the time out to review the document.

Have a great day!

Marissa



**To:** DeCair, Sara[DeCair.Sara@epa.gov]  
**Cc:** Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov];  
Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Thur 4/30/2015 8:51:44 PM  
**Subject:** drinking water PAG  
Revised Version 4-29-15 Draft Chapter Drinking Water PAG SHQ LC Alan Perrin.docx

Hi Sara –

I spoke with Alan about some concerns he had with how we addressed some comments. We agreed to revise the header for section 6.3 to:

Ex. 5 - Deliberative Process

## Ex. 5 - Deliberative Process

# Ex. 5 - Deliberative Process

I've attached a revised draft of the document that incorporates these changes.

Thanks-

Lisa

~~~~~  
Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

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1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]; Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Wed 4/29/2015 8:46:27 PM
Subject: FW: Revised Chapter Drinking Water PAG
Revised Version 4-29-15 Draft Chapter Drinking Water PAG SHQ LC.docx

Hi Sara – We’ve accepted all of your editorial modifications. Below is an explanation of how we addressed other comments/revisions. We’d like to use this as the draft for program management review, which we’d like to start as soon as OGC provides us with their comments – hopefully later this week.

Thanks-

Lisa

From: Hernandez-Quinones, Samuel
Sent: Wednesday, April 29, 2015 3:01 PM
To: Christ, Lisa
Cc: Ellis, Jerry
Subject: Revised Chapter Drinking Water PAG

Hi Lisa,

Attached is the revised version of the Chapter based on the discussion we had this morning. Also here are some general responses we had for Office of Air regarding their comments.

- 1) We want to keep the term “life-Stages” as it was specifically requested by Peter and it aligns with the terminology used by the Office of Water.

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Let me know if you have any comments or requests for additional changes.

Thank You

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

To: Burneson, Eric[Burneson.Eric@epa.gov]
From: Christ, Lisa
Sent: Thur 4/23/2015 8:10:01 PM
Subject: RP_AP-BR1-8_PAG-Manual_(DeCair)v2_ow.docx
RP_AP-BR1-8_PAG-Manual_(DeCair)v2_ow.docx
ATT00001.txt

Attached is a schedule we suggested and Sara et al are comfortable with. Below are TPs for Peter's conversation with Mike.

Ex. 5 - Deliberative Process

After we briefed the PAG interagency subcommittee on 1/22 and before we sent the revised proposal we had several rounds of OW and ORIA reviews.

We provided a version of the proposal both offices were comfortable with to the subcommittee on 3/3; comments were provided 3/18; OW and ORIA met to discuss addressing the comments on 3/31

A revised proposal incorporating the subcommittee comments was provided to OGC for review on 4/16

OGC comments are expected 4/30

To: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]
From: Christ, Lisa
Sent: Thur 4/16/2015 2:28:44 PM
Subject: revised chapter
Revised Version 4-14- Draft Chapter Drinking Water PAG V1_lc.docx

~~~~~  
Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

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Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M

**To:** Ellis, Jerry[Ellis.Jerry@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Thur 4/16/2015 2:35:52 PM  
**Subject:** action memo  
PAG Action Memo Water 4-1-2015\_J Ellis + lc.docx

~~~~~  
Lisa Christ, Chief

Targeting and Analysis Branch

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1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]; Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]; Burneson, Eric[burneson.eric@epa.gov]
From: Christ, Lisa
Sent: Thur 4/16/2015 7:12:09 PM
Subject: RE: PAGs project plan check-in
[Revised Version 4-16- Draft Chapter Drinking Water PAG V1 SHQ.docx](#)
[PAG Draft Action Memo Water 4-16-15.docx](#)
[V 2 DRAFT Drinking Water PAG Communications Plan 4-16-15.doc](#)
[Water PAG FR Notice draft 4-6-2015 OW.docx](#)
[Internal QandAs Drinking Water PAG 4-16-15.docx](#)
[RP AP-BR1-8 PAG-Manual \(DeCair\)v2 ow.docx](#)

Hi Sara –

Thanks for providing a revised schedule. I think we may be able to move things a little quicker (hopefully) than you've laid out. We'll do better keeping to this schedule!

Attached are several documents related to the PAG and schedule.

1. Updated PAG proposal chapter (based on PAG subcommittee comments)
2. Comments on the Action Memo
3. Draft OW communication plan
4. Comments on the FRN (note: as of this week there's a new FRN template)
5. Very draft internal Q&As
6. Feedback on the schedule

We intend to send the updated chapter to our OGC reviewer today and request comments by April 30.

Do you need our help coordinating OSWER and/or OHS review?

Thank you for your patience –

Lisa

From: DeCair, Sara
Sent: Monday, April 13, 2015 3:43 PM

To: Christ, Lisa
Cc: Veal, Lee; Perrin, Alan
Subject: PAGs project plan check-in

Lisa,

Lisa,

Lee and I were talking about getting your feeling on the dates for our next several steps on the drinking water PAG proposal. I know Sam's busy with the proposal edits right now, but maybe you can see if you think the months listed in the attached two page plan are achievable, given some unpredictability noted at the bottom.

When I talked with Jerry last week about Comms materials, we thought our ODs are a good audience for internal Qs and As and the messaging, since they want to feel knowledgeable and of course get to guide our next steps forward.

I'll be in my office Tuesday through Thursday this week and Lee will be traveling but available if we need to get on a call together. Thank you for any input you have on the timeline!

Sara 202-343-9108

Joint Briefing OW-OAR – Protective Action Guide (PAG) for Drinking Water

Purpose of this briefing:

- Present a recommendation for the Drinking Water PAG
- Discuss how we'll address the controversy associated with this proposal
- Agree on next steps toward publication for comment

What is the problem we're trying to solve?

- Drinking water is the only exposure pathway not currently addressed in the PAG Manual. At what radiation level does EPA recommend alternative drinking water resources be provided?
- Remember, a PAG is a health-based tipping point where actions are warranted to avoid a given radiation exposure.
- While highly unlikely, a large scale radiation contamination incident could impact the US, driving the need for a drinking water PAG that is pre-established and scientifically based.
- During the US response to the radiation incident at Fukushima, Japan in March 2011, rain water samples collected as part of RadNet showed concentrations of certain radionuclides above the SDWA Maximum Contaminant Levels (MCL).
- EPA experienced major difficulties conveying its message to the public that the detected levels in rain water, although greater than the MCL, were not of immediate concern to public health.
- If those same levels had been detected in drinking water, EPA may have had to issue ad-hoc guidance developed on short notice without the benefit of comprehensive analysis.

Options considered during PAG development:

- a) Do nothing. Local governments or states may develop individual PAG levels, or EPA will need to create one after an incident occurs. Experience has shown that local governments often rely on EPA advice when making decisions regarding the safe use of drinking water after contamination incidents. Radiation protection decisions are almost always based on federal guidance in some form. Affected federal entities (e.g., affected military personnel) will need federal guidance.
- b) Use the SDWA MCL (4 mrem) as the level to provide an alternate source of drinking water. MCLs are not intended to inform 'do not drink' levels, in addition MCLs are based on the assumption of a 70 year exposure timeframe.
- c) Adopt DHS & FDA benchmarks: 500 mrem from water for first year after an incident (DHS covers water after a terrorist attack and FDA guide applies to food). This allows for consistency with guidance that is already in use and publicly available.
- d) Adopt above benchmarks that have long-standing acceptance, and add additional protection for pregnant women and children: 500 mrem for the general population and a lower dose level for children and pregnant women.

Recommendation:

- Based on an analysis of radiation risks to all age groups from several nuclides, we propose a two-tiered PAG as a reasonable approach considering age-based radiosensitivity.
- We recommend the drinking water PAG during the intermediate phase of a radiological response be 75 mrem projected dose in the first year for infants, children and pregnant women and 500 mrem projected dose in the first year for the general population.

The protective action:

- The protective action is to restrict the use of contaminated water for drinking purposes and to provide alternative drinking water for the affected community. Options for providing alternate drinking water could include: bottled water, altering the raw water source of a water system, interconnection between systems, or a combination of these.

Rationale:

- EPA conducted an assessment of the projected risks of excess cancer cases from exposure to radiation in drinking water at the 500 mrem level for a one year duration incident. The projected risks levels for adults at the 500 mrem level generally fall around the 0.0003 risk level for excess cancer cases.
- EPA conducted a similar assessment from exposure to contaminated drinking water for infants and children, who are more sensitive to radiation exposure, and found that the projected risk level of 0.0001 would occur at the 75 to 100 mrem dose level range.
- This recommended drinking water PAG approach is consistent with PAGs currently in place for other media. PAGs are set by balancing the risks of exposure to radiation against the logistical difficulty, costs and detriments associated with taking protective action to avoid exposure.
- According to the International Commission on Radiation Protection, emergency levels for protection of people should be selected in the lower part of the 100 to 2,000 mrem/year recommended range. Protection against all exposures, above or below the PAG level, should be balanced against detriments from the protective action itself.
- The government of Japan adopted a similarly tiered drinking water advisory when responding to the radiation incident in Fukushima.
- We determined that it is not appropriate to base emergency protective actions and response measures during short-term radiation incidents on lifetime (70 year) exposure criteria utilized to derive SDWA Maximum Contaminant Levels (MCL).
- We recognize that within the SDWA framework, water systems in violation of drinking water standards have processes available to get back into compliance within a reasonable time frame. While the SDWA framework is useful to inform actions for day-to-day normal operations, it does not provide adequate guidance for emergency responders on what levels of contamination warrant providing alternative water.
- We assume that any drinking water system adversely impacted during a radiation incident will be able to achieve compliance with MCLs within the first year after the incident.

Key considerations:

- Flexibility is emphasized. Emergency managers should make incident specific decisions that make sense for their community.
- Some PAGs lend themselves to age specificity (KI, food, water) while others are best applied to entire populations (sheltering, evacuation, and relocation). The goal is to protect everyone, including the most sensitive (children and pregnant women) while being practical with what may be limited alternative drinking water resources.
 - From a public information standpoint, the Manual may need to provide further information on the practical implementation challenges with a two tier water protection strategy. The KI simplified approach is an example of this.
- Pre-incident planning is encouraged. Pre-incident planning can help a community identify the best alternative water choices.

Stakeholder reaction:

- In response to a previous proposal, anti-nuclear and environmental groups publicized misleading comparisons of derived water PAG concentrations alongside MCL concentrations to assert that the SDWA was being weakened. This is likely to happen again.
- In addition, these groups had multiple meetings with then Assistant Administrator Gina McCarthy and Deputy Administrator Bob Perciasepe to voice their concerns about the drinking water PAG development.
- Stakeholders base their strong objections and opposition on the fact that exposure to drinking water with higher levels of radiation will likely result in an increased risk of cancer cases. The stakeholders go into detail pointing out the differences in concentration levels derived from a PAG of 500 mrem in comparison with an MCL of 4 mrem. For some radionuclides, the resulting difference in concentration could be up to several thousand times.
- During Fukushima, the Agency was pressed to develop drinking water guidance for US citizens in Japan and those using cisterns with contamination from the incident. The Agency failed to provide any guidance. Since then, both Bob and Gina have encouraged us to get this done.
- State radiation control programs, nuclear power plant response communities, and the American Water Works Association have asked EPA repeatedly for a drinking water PAG for emergencies. Comments submitted on our 2013 PAG Manual from many states, the AWWA, Health Physics Society, Nuclear Energy Institute and Conference of Radiation Control Program Directors specifically request a drinking water PAG.

Proposed next steps in the timeline:

November 2014: Joint AA-level briefing for OW and OAR (scheduled for Nov. 5)

December 2014 – January 2015: Brief multi-agency PAGs Subcommittee & get concurrence on proposal; concurrently have updated drinking water proposal PAG reviewed by OSWER, OHS and OGC

February – March 2015: OW AA and OGC Review and Concurrence Process on drinking water PAG proposal and support documents

April 2015: Finalize drinking water PAG proposal *Federal Register* package

May 2015: OPEI review and facilitation

June 2015: Begin OMB 90-day review

Finalize edited FR Notice and drinking water PAG proposal **(OMB release + 14 days)**

Complete *Federal Register* Workflow for drinking water PAG proposal **(OMB release + 30 days)**

Public comment period **(OMB release + 90 days)**

Compile and adjudicate comments from public review **(OMB release + 120 days)**

Finalize entire PAG Manual including drinking water **(OMB release + 180 days = March 2016)**

Draft Protective Action Guide (PAG) for Drinking Water

1.0 INTRODUCTION

This proposal presents protective action guides and planning guidance to protect the public in the event of a radiological incident that affects drinking water supplies. A PAG is the projected dose to an individual from a release of radioactive material at which a specific protective action to reduce or avoid that dose is recommended.

The protective action for the drinking water exposure pathway is to restrict the use of contaminated water for drinking purposes and to provide alternative drinking water for the affected community. The drinking water PAGs apply during the intermediate phase of an incident, which may last for weeks to months.

2.0 THE DRINKING WATER PAG

EPA is proposing a two-tier drinking water PAG be used during the intermediate phase following a radiation incident: 500 mrem (5 mSv) projected dose¹ for the general population (defined as anyone over age 15, excluding pregnant women and nursing women), and 100 mrem (1 mSv) projected dose for pregnant women, nursing women, and children age 15 and under.

EPA expects that any drinking water system adversely impacted during a radiation incident will take action to return to compliance with Safe Drinking Water Act (SDWA) levels as soon as practicable. The proposed PAG is consistent with the other Protective Actions Guides currently in place for other media in the intermediate phase (i.e., the Food and Drug Administration's 500 mrem PAG for ingestion of food^{2,3}) and provides an additional level of protection for the most sensitive life stages. Intermediate phase doses can be projected using a one-year duration and compared to the PAG so that actions can be taken to avoid the exposure.

Section 7.0 explains how to calculate Derived Response Levels (DRLs) for radionuclides likely to appear in drinking water following a radiological contamination incident. DRLs are concentrations of radionuclides in drinking water that correspond to EPA's proposed PAG of 100 mrem and 500 mrem. DRLs are essential because a PAG identifies a radiation dose rather than a quantity of radionuclides that can be measured directly in drinking water. DRLs are expressed in units of picocuries per liter (pCi/L) or Becquerel per liter (Bq/L), and can be directly compared to measured radionuclide concentrations in drinking water supplies. In the absence of site-specific DRLs developed by emergency responders acquainted with local conditions, EPA recommends using these DRLs to guide actions to protect the public in the event of a radiological incident that affects drinking water supplies.

¹ All dose values expressed as Committed Effective Dose (CED) projected over one year.

² Food and Drug Administration (FDA). 1998. *Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations to State and Local Agencies*. Available online at: <http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>.

³ FDA. 2004. Supporting Document for Guidance Levels for Radionuclides in Domestic and Imported Foods. Docket No. 2003D-0558.

3.0 FACTORS EPA CONSIDERED WHEN ESTABLISHING THE DRINKING WATER PAG

Section 1.3.2 of the draft revised PAG manual⁴ provides the following three principles for establishing PAGs.

1. Prevent acute effects
2. Balance protection with other important factors and ensure that actions result in more benefit than harm
3. Reduce risk of chronic effects

The Agency crafted the drinking water PAG with these principles in mind. Specifically, consideration was given to the acute effects of exposure to radiation and lifetime risk of cancer based on age and drinking water intake. EPA made use of the risk conversion factors set forth in Federal Guidance Report No. 13 (FGR-13)⁵ and considerations of risk to the unborn set forth in National Council on Radiation Protection (NCRP) Report No. 174.⁶

In preparing this draft document, the Agency reviewed existing PAGs, thresholds, criteria and guidelines that have been established and proposed for protecting human health from a radiological incident, as discussed below. EPA also gave careful consideration to feedback received from public stakeholders on an earlier draft PAG manual,⁷ as it relates to public health protection from radiation exposure through drinking water.

The drinking water PAG was developed based on risks associated with ingesting drinking water contaminated with radionuclides. EPA also considered the potential radiation dose people could receive from various other uses of contaminated water, including showering, bathing, and dishwashing. In the United States, people typically shower, bathe, and wash dishes using the same source of water that they use to drink, but, for the radionuclides of interest, these activities generally represent much smaller risk than drinking contaminated water. Protection of a community's drinking water supply based on assumptions about ingestion will also protect the population from undue risk from contaminated drinking water by other routes of exposure.

⁴ EPA. 2013. Draft PAG Manual for Interim Use and Public Comment. Available online at: <http://www.epa.gov/radiation/docs/er/pag-manual-interim-public-comment-4-2-2013.pdf>.

⁵ EPA. 1999. Cancer Risk Coefficients for Environmental Exposure to Radionuclides. Federal Guidance Report #13. Available online at: <http://www.epa.gov/rpdweb00/docs/federal/402-r-99-001.pdf>.

⁶ Brent, R.L., Frush, D.P., Harms, R.W., and M.S. Linet. 2013. *Preconception and Prenatal Radiation Exposure: Health Effects and Protective Guidance*. National Council on Radiation Protection. Report #174.

⁷ Public feedback on the draft PAG Manual was requested in the Federal Register Notice Vol. 78, No. 72, p. 22257, April 15, 2013.

4.0 RATIONALE FOR A TWO-TIER DRINKING WATER PAG

In addition to a PAG of 500 mrem for the general population (i.e., anyone over age 15, excluding pregnant women and nursing women), EPA proposes establishing a more stringent PAG of 100 mrem to inform protective actions for pregnant women, nursing women and children. Fetuses, infants and children are at greater risk from radiological exposures than adults. This is due to the greater sensitivity of the developing body to the potential harmful effects of radiation and the longer dose commitment period for the longer-lived radionuclides that clear slowly from the body; a newborn that ingests radioactive material in water might be subject to the effects of that radiation for a longer period of time than an adult.

There are precedents for establishing a second, more protective threshold for radiological risks for younger members of the population due to the greater radiosensitivity of children versus adults. Following the Fukushima nuclear plant releases in 2011, the Japanese authorities set an emergency drinking water standard for infants that was one-third of the value for adults.⁸

PAGs and other guidance materials established by FDA for thyroid blocking with potassium iodide⁹ and for ingestion of food¹⁰ both include separate thresholds for more sensitive age groups.

Fetuses, infants and children are not a homogenous group. There are considerable differences in the transmission of radiological drinking water contaminants to a fetus via the placenta, to an infant via formula, and to a child via direct consumption. There also is considerable variation in the sensitivities of various organs to radiological threats in developing bodies. Nevertheless, for the sake of making clear and executable decisions in the intermediate phase of emergency response, EPA proposes a single PAG for these more sensitive members of the population. Keeping PAGs relatively simple helps to minimize confusion during their implementation. Therefore, DRLs provided in Section 7.0 were selected by assessing risks to all age groups and choosing the most conservative concentration to the most sensitive age group.

4.1 Rationale for selection of PAG values

The PAG of 500 mrem for the general population is consistent with the FDA food PAG¹¹

⁸ World Health Organization (WHO). 2011. FAQs: Japan nuclear concerns. Page 9, water contamination. September 2011. Available online at: <http://www.who.int/hac/crises/jpn/faqs/en/index8.html>.

⁹ FDA. 2001. *Guidance: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies*. Available online at: <http://www.fda.gov/downloads/Drugs/.../Guidances/ucm080542.pdf>.

¹⁰ FDA. 1998 *Accidental Radioactive Contamination of Human Foods and Animal Feeds: Recommendations for State and Local Agencies*. <http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>

¹¹ FDA. 1998 *Accidental Radioactive Contamination of Human Foods and Animal Feeds: Recommendations for State and Local Agencies*. <http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>

since many of the considerations for a food PAG also apply to drinking water. It is also consistent with the guidance value of 500 mrem over one year established by the Department of Homeland Security as an intermediate-level PAG for drinking water interdiction.¹²

A PAG of 100 mrem provides the most sensitive members of the population a reasonable level of protection from exposure to radioactivity in drinking water following a radiological incident. That value is comparable to the current public radiation protection standard of 100 mrem per year effective dose, as set forth in Nuclear Regulatory Commission (NRC) regulations (i.e., 10 CFR Part 20.1301). The International Commission on Radiation Protection¹³ recommends reference levels in the range of 20 to 100 mSv (2,000 to 10,000 mrem) for protection of human health in emergencies, and in the range of 1 to 20 mSv (100 to 2,000 mrem) for occupational exposure, exposure by caregivers, or residential radon exposure. EPA's proposed drinking water PAGs are at the lower end of the latter range.

Following the Fukushima nuclear plant releases in 2011, there was concern about levels of radioactive Iodine-131 (I-131) in drinking water. The Japanese authorities applied a two-tier set of provisional emergency standards to I-131 in water: 300 Bq/L (about 8,100 pCi/L) for adults, and 100 Bq/L (about 2,700 pCi/L) for infants (specifically for drinking water used to prepare baby formula). According to informational materials assembled by the World Health Organization in the wake of the incident,¹⁴ these emergency drinking water standards were provisional regulation values established by the Japanese Food Sanitation Act, as indicated by the Nuclear Safety Commission of Japan. These standards were precautionary and took international guidance into consideration, including recommendations of the International Atomic Energy Agency and the International Commission on Radiological Protection. The infant standard, furthermore, was equivalent to the international guideline set by Codex Alimentarius¹⁵ for infant food.

Under the Safe Drinking Water Act (SDWA), the Agency established maximum contaminant levels (MCLs) for radiological contaminants in drinking water. The National Primary Drinking Water Regulations (NPDWR) for radionuclides, set forth in 40 CFR 141, effectively adopt a dose-based limit of 4 mrem/yr for beta particle and photon radioactivity. These requirements are based on lifetime exposure criteria, which assume 70 years of continued exposure to contaminants in drinking water. The Agency determined that it is not appropriate to base protective actions during short-term emergency incidents on lifetime exposure criteria. While the SDWA framework is appropriate for day-to-day normal operations, it does not provide the necessary tools to

¹² See Table 1 in 73 FR 45029, <http://www.gpo.gov/fdsys/pkg/FR-2008-08-01/pdf/E8-17645.pdf>.

¹³ International Commission on Radiological Protection (ICRP). 2007. *The 2007 Recommendations of the International Commission on Radiological Protection*, Annals of the ICRP, Volume 37, Nos.2-4, 2007, Publication 103, ISSN 0146-6453, ISBN 978-0-7020-3048-2, pp. 96-98

¹⁴ WHO. 2011.

¹⁵ <http://www.codexalimentarius.org/about-codex/en/>.

assist emergency responders with determining the need for an immediate protective action. However, regardless of the cause of an incident, EPA expects that any drinking water system impacted during a radiation incident will take action to return to compliance with the National Primary Drinking Water Regulation (NPDWR) levels by the earliest feasible time.

5.0 INTERPRETING AND APPLYING THE PAG

The drinking water PAG is intended primarily to guide planning and decision-making efforts by local and state officials, including drinking water providers, during the intermediate phase of a radiological emergency when water supplies are particularly vulnerable to contamination from deposition of radioactive material from the atmosphere. Actions to protect water supplies may be implemented at other levels and at any time following a radiological incident, and even before an anticipated release occurs. The goal is to keep the dose to the public as low as reasonably achievable. Radiation doses should be reduced to below SDWA MCLs as soon as practicable.

5.1 Interpreting the two-tier PAG

EPA is proposing a two-tier PAG: 500 mrem for the general population (anyone over age 15, excluding pregnant women and nursing women) and 100 mrem for pregnant women, nursing women and children.

Authorities have flexibility on how to apply the PAG. In some cases they may find it prudent to use the PAG of 100 mrem as a target for the whole population, while in other circumstances, authorities may find that it makes sense to use both targets simultaneously. For example, emergency managers can use a two-tiered approach to focus on protecting the most sensitive population with limited alternate water resources. If bottled water must be rationed, for example, authorities may make the bottled water available to children, pregnant women and nursing women, and instruct the rest of the population to use a public drinking water supply that will satisfy the 500 mrem PAG.

As stated above, the PAGs are intended as guidance, and local authorities should take into account local circumstances (e.g., incident scope and community needs) when implementing a course of action to protect the public.

5.2 Operationalizing PAGs as Derived Response Levels (DRLs)

The PAG specifies a radiation dose to avoid via drinking water exposure projected over one year. In order to determine whether a PAG should be implemented, authorities will need to establish a relationship between the concentration of one or more radionuclides in a drinking water source and the radiation dose members of the population might experience as a result of drinking contaminated water. Incident-specific factors that may be taken into consideration include:

1. The radionuclides of concern
2. The rate and timing of entry of the radionuclides into a drinking water supply, via atmospheric deposition or by other means

3. The rate of natural attenuation of the radionuclides
4. The estimated potential duration of public exposure to contaminated drinking water
5. The estimated daily consumption of contaminated drinking water

Those responsible for implementing PAGs will need to convert PAGs into Derived Response Levels (DRLs) in units of Bq/L or pCi/L. Section 7.0 of this document provides DRLs and explains how they can be calculated. Selected dose conversion factors and standard estimates of daily drinking water consumption for various age groups are also provided, along with references to informational resources.

While the PAG Manual is primarily for advance planning, there are specific radionuclides, including cesium-137 (Cs-137), iodine-131 (I-131) and strontium/yttrium-90 (Sr-90/Y-90) that are of particular interest for radiological incident scenarios where drinking water sources might be contaminated. Section 7.0 presents default DRLs for these radionuclides to aid emergency managers in making water restriction decisions involving these contaminants. DRLs for these radionuclides are presented as examples for purpose of illustration. If other radionuclides are present, DRLs should be calculated using the same methodology, as discussed in Section 7.0.

5.3 Practical Considerations

After deposition has ended, radionuclide concentrations present in a water supply may decline at rates determined by half-lives of the individual nuclides, or may decline faster by dilution with uncontaminated water, or may even increase after rainfall events. The concentration of radionuclides in drinking water as a function of time after the incident can be measured, estimated or modeled based on knowledge of the incident, including radionuclide sources and the properties of the drinking water supply. Such estimates should be validated by monitoring or sampling, as discussed in Section 6.1.

Unlike naturally-occurring radionuclide contamination of drinking water from minerals present in geological formations, for a radiation incident release, ground water supplies are expected to be less vulnerable to contamination than surface water supplies, but this should be confirmed by monitoring or sampling. The potential for ground water to become contaminated will greatly depend on whether the ground water resource is close to the surface or is from a deep aquifer bounded by an aquitard, as well as on rainfall rate and the composition of the overlying soil (which will affect the rate at which contaminants deposited on soil will migrate to the ground water resource).

A PAG is intended as a point of reference to aid emergency response managers in their decision-making. After a particular situation stabilizes and becomes more clearly defined, local authorities may wish to modify the PAG level they consider to be appropriate in order to implement longer-term dose reduction strategies. Decision makers may also want to consider lower dose levels for a drinking water PAG, depending on available resources and needs of an individual community. EPA expects

that any drinking water system adversely impacted during a radiation incident will take action to return to compliance with NPDWR levels as soon as practicable.

Section 6.3 discusses actions that authorities can take to minimize radiation doses. Because radionuclides decay over time, early interventions such as restricting use of contaminated water immediately after the incident may be most effective in reducing radiation dose to the population. Such decisions may need to be made based on limited information. Authorities may find it prudent to take such action even before field sample measurements or modeled estimates of radiation dose have been calculated and validated.

6.0 PLANNING AND TAKING ACTION

This section discusses actions that state and/or local authorities and drinking water utilities can take to protect the public in the event that a water supply is affected by a significant radiological contamination incident. This section does not constitute a complete handbook for radiological emergency response, but it describes considerations that can be included in comprehensive emergency planning at the state, local and utility level. Actions that public authorities and drinking water providers should take include water monitoring (described in Section 6.1), public notification (described in Section 6.2), and mitigation measures to protect the water supply and the water-consuming public (described in Section 6.3).

Preventive action, such as temporary closure of water system intake valves to prevent a contaminant plume from entering the system, may be taken in advance of an anticipated release; it is not necessary to wait until drinking water contamination is detected. Of course, emergency response plans need to consider whether sufficient storage capacity is available to support the community's fire suppression and sanitation needs while the intake valves are closed.

Emergency planning provides the opportunity to develop state, local and utility-specific plans and implementation procedures that reflect the unique needs of a particular community. Advance planning can provide clarity and facilitate the decision-making process during a radiological emergency.

6.1 Monitoring and Characterization of Contaminants

A comprehensive radiological surveillance program to monitor concentrations of radionuclides of interest in both source water and finished drinking water will provide an indication of whether any adjustments are necessary or if the actions being taken are effective.

The NPDWR for radionuclides requires community water systems (CWSs) to conduct monitoring at each entry point to the distribution system to ensure that every customer's water does not exceed the MCLs for radionuclides.¹⁶ All CWSs are required to monitor

for gross alpha, radium-226/228, and uranium. In addition, CWSs designated by the state as “vulnerable”¹⁷ and those using waters “contaminated”¹⁸ by effluents from nuclear facilities must also conduct monitoring for beta particle and photon radioactivity. If a water system is directed by the primacy agency to collect samples for compliance purposes, approved analytical methods must be used.

In the event of a radiological contamination incident, state officials may require public water systems to immediately collect additional samples for radionuclides, including beta particle and photon activity. However, EPA recognizes that during an emergency situation it may be necessary to identify alternative sampling and analytical approaches to obtain data to inform short-term actions by emergency response personnel. Many states have established Radiological Emergency Preparedness programs designed to guide sample collection and analysis and to advise emergency managers in a radiological emergency. Additionally, the Federal Radiological Monitoring and Assessment Center (FRMAC) can deploy monitoring and sampling field teams and provide dose assessment expertise to assist states and local communities in responding to an emergency. See the National Response Framework, Nuclear/Radiological Incident Annex¹⁹ for information on roles and capabilities.

EPA provides rapid laboratory analysis methods for selected radionuclides to expedite the analytical turnaround time while simultaneously meeting measurement quality objectives.²⁰ Challenges may arise from variability in environmental matrices. Advance emergency planning can help to achieve sample representativeness and homogeneity relative to routine samples.

If members of the public are served by drinking water from household cisterns or private wells, local officials should consider how monitoring should be undertaken to determine levels of target radionuclides and assess the risks posed to these populations.

6.2 Public Notification

An emergency response plan should include a strategy for keeping the community informed of the actions being taken by authorities and clearly delineate roles and responsibilities of local officials and emergency responders. This includes communicating to customers of CWSs and (if applicable) to those who rely on household cisterns and private wells. It is critical for water utilities to participate in the emergency response planning activities.

¹⁶ For more information about monitoring requirements for the Radionuclides Rule see the “Radionuclides Rule: A Quick Reference Guide” (EPA 816-F-01-003, June 2001) or “Implementation Guidance for Radionuclides” (EPA 816-F-00-002, March 2002).

¹⁷ For more information see 40 CFR 141.26(b)(1).

¹⁸ For more information see 40 CFR 141.26(b)(2).

¹⁹ Document is available online at: <http://www.fema.gov/media-library/assets/documents/25554>

²⁰ EPA. 2014a. Rapid Radiochemical Methods Applicable to Selected Radionuclides for Environmental Remediation Following Radiological Incidents. Third Edition. Front matter available online at: <http://www.epa.gov/narel/Docs/Preface%20to%203rd%20Edition%20%28Online%29%2004-16-14.pdf>. Rapid methods are available online at: http://www.epa.gov/narel/rapid_methods.html

If compliance monitoring indicates that contamination levels exceed the MCL for any radionuclide, water systems are required to issue public notice on a “Tier 2” time frame (i.e., as soon as practical, but no later than 30 days after the system learns of the violation). However, States may determine that the notification requirement should be elevated to a “Tier 1” Public Notification (i.e., as soon as practical, but no later than 24 hours) based on a significant potential for serious adverse effects on human health due to short-term exposure.²¹

During a response to a radiological event, water systems may have difficulty with issuing public notifications in addition to managing the response to the contamination event. The state may issue public notification on behalf of the water system (40 CFR 141.210(a)). This would allow the state to deliver a consistent message to all affected customers and allow the system to concentrate its efforts on returning to operation or returning to compliance in the event of a radionuclides MCL violation. For more information see the Revised Public Notification Handbook (EPA 816-R-09-013, March 2010).

State and local authorities should be proactive in communicating about risks and uncertainties and providing clear instructions to the public. For any incident response requiring coordinated federal support, refer to the National Response Framework and Emergency Support Function 15, External Affairs Annex, for roles and response protocols.

6.3 Additional Actions to Reduce Levels of Contamination

In the initial phase following a radiological incident, officials should take reasonable precautionary measures to protect water supplies as soon as notification of a radiological release or impending release is received. As data are obtained from monitoring programs (including sampling and analysis of water upstream and downstream of a water system intake structure and within the distribution system) and observed concentrations are benchmarked against derived response levels (DRLs) calculated from the PAGs, officials can make informed decisions about the need to implement protective actions in the intermediate phase. Water system officials should be in close communication with their primacy agency (e.g., state/county regulators) prior to taking protective actions.

Options available to water systems to reduce radiation dose to drinking water customers during the intermediate phase include applying treatment technologies, relying on back-up storage, blending water, accessing alternative water supplies, and rationing of uncontaminated water. Examples of these options are described briefly below. Technical and economic burden on smaller systems may be reduced by pooling resources with other water systems (e.g., establishing interconnections, sharing technical and operator staff, and sharing of supplies and equipment). As part of

²¹ For more information see 40 CFR 141.202(a), Table 1(9), Special public notices: Occurrence of a waterborne disease outbreak or other waterborne emergency.

emergency planning efforts, local officials should consider the possibility of temporary rationing of uncontaminated or treated water if supplies are inadequate to meet normal demand.

Many of these options require advanced planning. Guidance on developing emergency drinking water supplies is available from EPA.²² The Centers for Disease Control and Prevention also provide resources and guidance for establishing emergency water supplies and communicating water advisories to the public.²³

6.3.1 Treating Contaminated Water

Systems can treat contaminated water to reduce elevated radionuclide levels. Four treatment technologies are classified by EPA as Best Available Technologies (BATs) for removing radionuclides from drinking water: coagulation/filtration, ion exchange, lime softening and reverse osmosis. EPA has also listed these BATs as Small System Compliance Technologies (SSCTs) for radionuclides treatment, along with less commonly used techniques such as green sand filtration, co-precipitation with barium sulfate, electrodialysis/electrodialysis reversal, pre-formed hydrous manganese oxide filtration and activated alumina. Further information on radionuclide treatment options is available from EPA.²⁴

Removal efficiency for specific radionuclides will vary across available technologies and may depend on technology-specific parameters (e.g., ion exchange effectiveness depends on pH, resin selected and presence of other ions). In addition, liquid and solid treatment residuals with elevated radiation levels may have special disposal requirements. Disposal options may vary from one jurisdiction to another, and may depend on the type, concentration and volume of residuals. Further information on residual disposal considerations is available from EPA.²⁵

6.3.2 Temporarily Closing Intake Valves

If the deposition of radionuclides into a river is limited in duration, only a portion of the water may become contaminated. A water system with enough storage capacity can temporarily close its intake valves and allow the contaminants to flow past the intake to prevent contamination from entering the distribution system.

²² EPA. 2011b. *Planning for an Emergency Drinking Water Supply*. EPA 600/R-11/054, June 2011.

²³ CDC. 2014. Drinking Water Advisory, Planning, & Emergency Response Resources. Available on the Internet at: <http://www.cdc.gov/healthywater/emergency/drinkingwateradvisory.html>. Last updated December 2, 2014.

²⁴ EPA. 2015a. Radionuclides in Drinking Water -- Compliance Options: Treatment Technology Descriptions. Available on the Internet at: <http://cfpub.epa.gov/safewater/radionuclides/radionuclides.cfm>. See also EPA. 2002a. *Radionuclides in Drinking Water: A Small Entity Compliance Guide*. EPA 815-R-02-001, 2002. (http://www.epa.gov/safewater/radionuclides/pdfs/guide_radionuclides_smallsystems_compliance.pdf).

²⁵ EPA. 2006a. *A System's Guide to the Management of Radioactive Residuals from Drinking Water Treatment Technologies*. EPA 816-F-06-012, August 2006. See also EPA. 2006b. *A System's Guide to the Identification and Disposal of Hazardous and Non-Hazardous Water Treatment Plant Residuals*. EPA 816-F-06-011, August 2006.

If stored water supplies are not sufficient to meet community fire suppression and sanitation needs while intake valves are closed, the system could take other actions discussed in this section, including supplementing water supplies with alternate sources or implementing water use restrictions.

6.3.3 Establishing Interconnections to Neighboring Systems

If the water system is part of a larger, regional supply system, existing interconnections to an uncontaminated neighboring water supply could be activated. It might also be possible to construct temporary pipelines on an impromptu basis.

If this option is implemented, steps should be taken to prevent backflow from the contaminated system. Care will also need to be taken to ensure that the supply of water and treatment capacity at the uncontaminated system will adequately serve the larger population.

6.3.4 Blending Water Sources

If a source of uncontaminated water is available, a water system may choose to blend water from contaminated and uncontaminated sources of drinking water. The water may be blended using storage tanks or a common header to allow for complete mixing prior to distribution to customers.

6.3.5 Importing Water in Tanker Trucks

Under some circumstances (e.g., difficult terrain, urgent need), it may be more efficient or expedient to temporarily transport clean water by truck, rail or barge to distribution centers in the affected community than to lay down pipelines. State and local departments of public health, as well as emergency management agencies, typically have standards and requirements related to hauling water. Water systems would benefit from having procedures for importing water in tanker trucks documented in an emergency response plan. All water systems importing water by tanker should verify that their plan adheres to state and local requirements. If the water system's distribution system is not being used to provide the imported water, the needs of residents with limited transportation options and physical disabilities should be taken into account when selecting locations for distribution centers. The availability of suitable transport vehicles may limit use of this option.

6.3.6 Importing Bottled Water

Providing bottled water to the affected community is another possible option during an emergency situation. The water may come from a nearby water system or from a water bottling company. This option may be cost-effective during an emergency if water is needed quickly and if the length of the emergency does not require long-term action, such as the construction of an interconnecting pipe.

7.0 DERIVED RESPONSE LEVELS (DRLS)

EPA developed the radionuclide-specific DRLs by calculating the radionuclide concentrations in drinking water that would result in projected radiation doses of 100 and 500 mrem , assuming one year of continuous exposure and average drinking water intake rates for children and adults.

Several considerations should be kept in mind when using these pre-calculated DRLs. The DRLs presented in Table 1 are calculated on the assumption that each radionuclide is the only radionuclide present in drinking water. DRLs are additive. In situations where multiple radionuclides are present, DRLs should be combined using a sum of fractions. (An example calculation is provided in Section 7.1.) Table 1 does not present DRLs for all radionuclides that may occur in drinking water following a contamination incident.

These DRLs were calculated using a simplifying and conservative assumption that radionuclide levels will remain constant over the course of one year. This provides an added level of protection in light of the many unknowns involved in an emergency. In fact, after the initial deposition event has occurred, concentrations may decline at rates determined by the half-lives of individual isotopes, or decline faster due to dilution with uncontaminated water, or could even increase after rainfall or subsequent deposition events. Some nuclides, like I-131, have half-lives measured in days, while others, like Cs-137, have half-lives measured in years. Early exceedance of the DRL does not preclude the possibility that doses will stay below PAGs as radionuclide concentrations in water decline by a combination of radioactive decay and natural attenuation. If the concentrations of radionuclides do not exceed DRLs over the course of one year, doses will remain below the PAG.

Table 1. Derived response levels (DRLs)²⁶ -- drinking water concentrations corresponding to specified doses (mrem) of select radionuclides, assuming one year of exposure at constant levels²⁷

	DRLs for pregnant women, nursing women and children age 15 and younger – 100 mrem dose	DRLs for adults (excluding pregnant women and nursing women) – 500 mrem dose

²⁶ Values provided in this table have been rounded.

²⁷ The calculated values provided in this table are intended to illustrate the methodology and conservative assumptions EPA believes are adequate to provide a reasonable level of protection to sensitive populations. Additional information including updated dose conversion factors, calculation methodologies as well as other comprehensive information regarding DRL development will be appended to the FRMAC Assessment Manual.

²⁸ Y-90 is a radioactive decay product of Sr-90 and will normally be found alongside Sr-90 in the case of a Sr-90 release; therefore they are treated together. Solubility differences may cause less Yttrium to be present, however it is a conservative assumption to include both in DRLs. When calculating the combined DRL, note that

Sr-90/Y-90 ²⁸	1,000 pCi/L	7,400 pCi/L
Cs-137	6,140 pCi/L	16,570 pCi/L
I-131	1,300 pCi/L	10,350 pCi/L

The DRLs provided in Table 1 were derived by calculating life stage-specific DRLs (as described in section 7.2) for six different ages (Infant, 1, 5, 10, 15, and adults). For the most sensitive life-stages concentrations of individual radionuclides yielding a 100 mrem dose were calculated for each age group, then the most protective/lowest radioactivity concentration was selected as the DRL for the entire sensitive life-stage group, including pregnant and nursing women. The calculated values differ across individual life-stages because each age group has a different dose conversion factor and drinking water ingestion rate. For example, in the 15-and-younger category, the most limiting concentration for I-131 is for the 5 year old and the most limiting concentrations for Sr-90/Y-90 and Cs-137 are for the 15 year old.

For example, the sensitive life-stage group DRL for I-131 was derived by calculating the concentration of I-131 which yields a 100 mrem dose for each age group. In this case the resulting concentrations were: infants (2,110 pCi/L), 1 yr (1,860 pCi/L), 5 yr (1,310 pCi/L), 10 yr (1,950 pCi/L), and 15 yr (2,410 pCi/L). Since the lowest calculated concentration corresponds to the 5 year old (1,310 pCi/L), this value is the DRL that will be applied to be the most protective for the entire sensitive life-stage group.

7.1 Calculation of DRLs

DRLs may be calculated with the help of the following equations.

The quantity of radionuclide i ingested by age group a over a given time period, T , is calculated as follows.

$$I_{iaT} = C_i \times \text{Ing}_a \times T$$

Where:

I_{iaT} = The total intake of radionuclide i for age group a (in pCi or Bq) over time period T .

C_i = The concentration of radionuclide i in drinking water (in pCi/L or Bq/L). A simplifying assumption is made that the concentration of the radionuclide is constant over the time period T .

Ing_a = The daily ingestion rate of water for age group a , in L/day. See Section 7.3 for guidance on daily water ingestion rates.

the dose coefficients (see Table 3) are additive.

T = The time period that the population is drinking contaminated water (days). In this analysis, the time period of interest is 365 days.

The dose (mrem or Sv) due to the ingestion of radionuclide i to age group a over time period T is calculated as follows:

$$D_{iaT} = I_{iaT} \times DCF_{ia}$$

Where:

D_{iaT} = Dose (in mrem or Sv) due to the ingestion of radionuclide i to age group a over time period T

I_{iaT} = The total intake of radionuclide i for age group a (in pCi or Bq) over time period T

DCF_{ia} = The dose conversion factor (also referred to as dose coefficient) for the ingestion of radionuclide i in drinking water and age group a (in mrem/pCi or Sv/pCi, or mrem/Bq or Sv/Bq). See section 7.4 for guidance on DCFs.

For each age group a and radionuclide i , substituting the applicable PAG for the dose D_{iaT} and then solving for C_i yields the applicable DRL. For example, the DRL for Iodine-131 for an adult is as follows:

$$DRL = PAG / (Ing_a * T * DCF_{ia})$$

$$\begin{aligned} DRL &= 500 \text{ mrem} / (1.643 \text{ L/day} * 365 \text{ days} * 8.05 \text{ E-05 mrem/pCi}) \\ &= 500/4.83 \text{ E-02} \\ &= 10,352 \text{ pCi/L} \end{aligned}$$

Which is best rounded to 10,350 pCi/L considering the uncertainties.

7.2 Combining DRLs for Multiple Radionuclides

If multiple radionuclides are present in the water supply, then it is recommended that the obtained concentrations of each radionuclide be divided by the provided DRL values. This provides a fraction of the allowed concentration (and the projected dose) for each radionuclide. If the sum of the fractions is less than 1, the total dose is assumed to be below the PAG values. Emergency response personnel may need to calculate the sum of fractions on an ongoing basis, as the concentrations of individual radionuclides may change over time. The sum of the fractions is expressed as follows:

$$F = \sum (C_i / DRL_i)$$

Where:

F = sum of the fractions

C_i = the concentration of radionuclide i in the water supply (pCi/L or Bq/L)

DRL_i = derived response level for the i^{th} radionuclide (pCi/L or Bq/L)

For example, if Sr-90/Y-90 and Cs-137 are the only radionuclides present in the drinking water, and Sr-90/Y-90 are present at 1,540 pCi/L and Cs-137 is present at 10,600 pCi/L, the combined dose exceeds the PAG of 100 mrem for fetuses, infants, and children:

$$\begin{aligned} F &= \sum (C_i / DRL_i) \\ &= (1,540 \text{ pCi/L} / 1,000 \text{ pCi/L}) + (10,600 \text{ pCi/L} / 6,140 \text{ pCi/L}) \\ &= 1.54 + 1.73 \\ &= 3.27 \\ 3.27 &> 1, \text{ so the PAG is exceeded.} \end{aligned}$$

The same concentrations do not exceed the PAG of 500 mrem for adults:

$$\begin{aligned} F &= \sum (C_i / DRL_i) \\ &= (1,540 \text{ pCi/L} / 7,415 \text{ pCi/L}) + (10,600 \text{ pCi/L} / 16,570 \text{ pCi/L}) \\ &= 0.21 + 0.64 \\ &= 0.85 \\ 0.85 &< 1, \text{ so the PAG is not exceeded.} \end{aligned}$$

7.3 Water Ingestion Rates

Table 2 presents mean values for tap water consumption taken from the CD supplement to FGR-13.²⁹ Other sources of estimated drinking water ingestion rates are available (e.g., EPA's *Exposure Factors Handbook*³⁰), but the ingestion rates presented in FGR-13 were specifically designed with corresponding age ranges to be used in conjunction with other data from FGR-13. Values are provided for males and females in various age groups. Since the ingestion rates for males are higher (and therefore more conservative) than those for females, EPA elected to use the intake values for males to

²⁹ EPA. 2002b. Federal Guidance Report 13. Cancer Risk Coefficients for Environmental Exposure to Radionuclides: CD Supplement, EPA-402-C-99-001, Rev. 1.

³⁰ EPA. 2011a.

represent each age group in the calculation of DRLs in Table 1. In addition, for the calculation of the adult DRL, EPA made the conservative assumption that the ingestion rate would be assigned the highest value within the adult category, the 50 year old male, at an estimated 1.643 L/day.

Table 2. Mean Drinking Water Ingestion Rates from FGR-13

Age (years)	Tap Water (L/day)	
	Male	Female
0	0.191	0.188
1	0.223	0.216
5	0.542	0.499
10	0.725	0.649
15	0.900	0.712
20	1.137	0.754
50	1.643	1.119
75	1.564	1.179

Source: CD Supplement to FGR-13, Table 3.1.

7.4 Dose Coefficients, or Dose Conversion Factors (DCF) (Sv/Bq Ingested)

The effective whole body dose per Bq ingested of various radionuclides in water, for various age groups, can be found on the CD supplement to FGR-13.³¹ These DCF values apply to both males and females. Table 3 presents DCFs for a few representative radionuclides of interest, converted to U.S. units for convenience.

Table 3. Dose Conversion Factors³²

Age	DCFs (mrem per pCi ingested), from FGR-13			
	Sr-90	Y-90	Cs-137	I-131

³¹ EPA. 2002

³² The DCFs in this table show the variation across age groups and nuclides and are provided to illustrate the conservative methodology and assumptions EPA believes are adequate to provide a reasonable level of protection to sensitive populations. Additional information including updated dose conversion factors, calculation methodologies as well as other comprehensive information regarding DRL development will be appended to the FRMAC Assessment Manual.

Infant (100 day old)	8.40E-04	1.16E-04	7.79E-05	6.82E-04
1 year old	2.68E-04	7.41E-05	4.58E-05	6.62E-04
5 year old	1.73E-04	3.69E-05	3.58E-05	3.83E-04
10 year old	2.21E-04	2.18E-05	3.75E-05	1.94E-04
15 year old	2.92E-04	1.24E-05	4.95E-05	1.27E-04
Adult	1.02E-04	9.94E-06	5.02E-05	8.05E-05

Source: CD Supplement to FGR-13.

OSWER Comments on draft Protective Action Guide (PAG) for drinking water

August 3, 2015

Thank you for providing OSWER the opportunity to review the draft Protective Action Guide (PAG) for drinking water. We have a number of overarching comments, provided below. In addition, we have provided detailed comments in the draft document.

In generating our overarching comments, we have reviewed the proposed drinking water PAG in the context of the larger draft document 'PAG Manual'. Our assumption is that the new draft will be in some way incorporated into that larger document, although exactly where it will be placed is not clear to us.

Overarching Comments

1. We recommend that the document explicitly discuss consideration of the following response options, based on what is achievable and is consistent with the agency's emergency response program approach , for providing drinking water, e.g.:
 - i. Alternate Supply of Drinking Water
 - ii. Dilution/Blending
 - iii. Treatment
 - iv. PAGs

OGWDW intends to prepare implementation guidance for public water systems to provide additional information on analytical methods and certified laboratories, practical considerations for options for providing alternative water and communicating with primacy agencies and the public.

This list of options should be footnoted with the following language already included in the PAG document [p. 53]:

In the United States, a range of one in a population of ten thousand (10^{-4}) to one in a population of one million (10^{-6}) excess cancer incidence outcomes is generally considered protective for both chemical and radioactive carcinogenic contaminant exposures. This range is the regulatory standard generally used in the context of EPA Superfund response actions. The NRC's decommissioning and decontamination process outcomes are usually in or near this range as well. A similar risk range may be an appropriate goal for radiological events that affect areas of comparable size. However, such risk ranges may not be practically achievable for major incidents that result in the contamination of very large areas. In making decisions about cleanup goals and strategies for a particular event, decision makers must balance the desired level of exposure reduction with the extent of the measures that would be necessary to achieve it, in order to maximize overall human welfare.

While it may take many years to achieve final cleanup levels, a timely return to normalcy, including reoccupancy and a viable community, will require a cleanup process that is flexible, iterative and inclusive. Decisions must be made on a site-specific basis and should reflect the interim risks that are reasonable and acceptable to the affected

community as active remediation, radioactive decay and natural weathering move the site toward long-term cleanup goals.

We agree that the footnote should be included in the PAG Manual.

2. The document needs to clearly state that the PAG is not appropriate for CERCLA remedial response/cleanup. We note that there is language to this effect in the draft PAG Manual (e.g., page i [saying that the PAG Manual does not impact CERCLA response], and pages 10 and 52 [saying that Chapter 4 of the PAG Manual does not impact the CERCLA remedial program]), but we found the drafting drinking water PAG lacks this information.

We agree that these footnotes should be included in the PAG Manual.

3. We could not identify a place in the current draft PAG Manual where the draft drinking water PAG can be seamlessly inserted. Since context for this information is clearly critical, we request to see the revised document prior to OMB submission and finalization.

OSWER will have the opportunity through the OP review process.

4. The document needs to provide greater clarity and context regarding appropriate use of the drinking water PAG value. The document provides contradictory information with respect to the expected time period of use. For example, in the draft PAG manual, p. 5 defines intermediate phase as 'weeks to months', but p. 5 of the draft drinking water PAG includes the language "...dose via drinking water exposure per each year of the intermediate phase" (implying that the intermediate phase could last multiple years). Greater clarity should be provided regarding the anticipated appropriate exposure period. We propose (in addition to clarifying the apparently contradictory statements) that language be included to indicate that a re-evaluation of response options should be conducted in the event that exposure is expected to continue beyond one year.

We will clarify the language to be consistent throughout the PAG Manual. OGWDW assumed a one year period for purposes of our risk analysis to derive the two-tier PAG values.

5. We believe that it may be difficult to implement a two-tiered system such as that proposed in the document (i.e., 100 mrem for potentially sensitive populations, 500 mrem for the general population). We understand why a separate value for sensitive populations would be useful, but we think that it may be easier to use a single value for the entire population that is protective of sensitive populations. Some specific issues related to use of a two-tiered system are described in our detailed comments in the draft document.

We do not believe this will be difficult to implement and at a minimum, the Agency should take comment on this approach. The drinking water sector is familiar with two-tier advisory levels. In May, 2015, OW published Health Advisory levels for cyanotoxins in public water systems (one for the general public and a second level for children). Many other drinking water health advisory levels have separate values for the general public and children.

6. We note that the Derived Intervention Levels (DILs) in the referenced FDA document, *"Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations to*

State and Local Agencies" (1998) explicitly include drinking water as part of their calculations (cf., the statement: "Food intake included all dietary components including tap water used for drinking, and is the overall quantity consumed in one year" [p. 31]). We recommend maintaining consistency with FDA in considering risk from all dietary components, and recommend providing information on how to address cumulative exposures from food and drinking water.

We will add clarifying language on how drinking water is considered in the FDA food PAG.

7. Related to the above, some discussion should be included regarding whether the drinking water PAG values are intended to be stand-alone exposure values, or whether they might need to be modified to account for exposure from other sources (e.g., intake of contaminated food, inhalation of contaminated dust, ...). Since the FDA document derives 500 mrem as a value meant to include all dietary intake, the drinking water PAG document should discuss any discrepancy with that recommendation.

We will add language to the PAG Manual regarding cumulative risk.

8. We note that the draft drinking water PAG discussed multiple international standards at various locations in the document. We recommend that a separate appendix be developed to provide information regarding these various international documents (as well as documents from other US government agencies). The appendix could then be cited as needed within the text of this section.

We will insure international standards are properly referenced throughout the PAG Manual, but will not create a separate appendix.

9. We were unable to determine how the derived response levels (DRLs) in the draft document were calculated. The derivation of the DRL values needs to be transparently documented (i.e., specific values and calculations provided, including assumptions such as water consumption rates [and the source of those values]). The reason for the discrepancies between the DRL values in this document and those for the same contaminants in other international documents also needs to be clearly explained. We have provided examples of some of these discrepancies in our detailed comments.

OGWDW, ORIA and OSWER staff met on 8/18/2015 to discuss the assumptions and methodology used for calculating the DRLs.

10. Some consideration should be given as to whether the discussion of fetal exposure may provide too much detail for a document of this type. We believe that use of a single exposure tier would eliminate the need for a specific discussion of this topic [see our detailed comments in the draft document].

We will revise the language to ensure it's not too detailed.

Draft Protective Action Guide (PAG) for Drinking Water

1.0 INTRODUCTION

This chapter presents protective action guides and planning guidance to protect the public in the event of a radiological incident that affects drinking water supplies. A PAG is the projected dose to an individual from a release of radioactive material at which a specific protective action to reduce or avoid that dose is recommended.

The protective action for the drinking water exposure pathway is to restrict the use of contaminated water for drinking purposes and to provide alternative drinking water for the affected community. The drinking water PAGs apply during the intermediate phase of an incident, which may last for weeks to months.

2.0 THE DRINKING WATER PAG

EPA is proposing a two-tier drinking water PAG be used during the intermediate phase following a radiation incident: 500 mrem (5 mSv) projected dose¹ for the general population (defined as anyone over age 15, excluding pregnant women and nursing women), and 100 mrem (1 mSv) projected dose for pregnant women, nursing women, and children age 15 and under.

EPA expects that any drinking water system adversely impacted during a radiation incident will take action to return to compliance with Safe Drinking Water Act (SDWA) levels as soon as practical. The proposed PAG is consistent with the other Protective Actions Guides currently in place for other media in the intermediate phase (i.e., the Food and Drug Administration's 500 mrem PAG for ingestion of food^{2,3}) and provides an additional level of protection for the most sensitive life stages. Intermediate phase doses can be projected using a one-year duration and compared to the PAG so that actions can be taken to avoid the exposure.

Section 7.0 explains how to calculate Derived Response Levels (DRLs) for radionuclides likely to appear in drinking water following a radiological contamination incident. DRLs are concentrations of radionuclides in drinking water that correspond to EPA's proposed PAG of 100 mrem and 500 mrem. DRLs are essential because a PAG identifies a radiation dose rather than a quantity of radionuclides that can be measured directly in drinking water. DRLs are expressed in units of picocuries per liter (pCi/L) or Becquerel per liter (Bq/L), and can be directly compared to measured radionuclide concentrations in drinking water supplies. In the absence of site-specific DRLs developed by emergency responders acquainted with local conditions, EPA recommends using these DRLs to guide actions to protect the public in the event of a radiological incident that affects drinking water supplies.

¹ All dose values expressed as Committed Effective Dose (CED) projected over one year.

² Food and Drug Administration (FDA). 1998. *Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations to State and Local Agencies*. Available online at: <http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>.

³ FDA. 2004. Supporting Document for Guidance Levels for Radionuclides in Domestic and Imported Foods. Docket No. 2003D-0558.

3.0 FACTORS EPA CONSIDERED WHEN ESTABLISHING THE DRINKING WATER PAG

Section 1.3.2 of the draft revised PAG manual⁴ provides the following three principles for establishing PAGs.

1. Prevent acute effects
2. Balance protection with other important factors and ensure that actions result in more benefit than harm
3. Reduce risk of chronic effects

The Agency crafted the drinking water PAG with these principles in mind. Specifically, consideration was given to the acute effects of exposure to radiation and lifetime risk of cancer based on age and drinking water intake. EPA made use of the risk conversion factors set forth in Federal Guidance Report No. 13 (FGR-13)⁵ and considerations of risk to the unborn set forth in National Council on Radiation Protection (NCRP) Report No. 174.⁶

In preparing this draft document, the Agency reviewed existing PAGs, thresholds, criteria and guidelines that have been established and proposed for protecting human health from a radiological incident, as discussed below. EPA also gave careful consideration to feedback received from public stakeholders on an earlier draft PAG manual,⁷ as it relates to public health protection from radiation exposure through drinking water.

The drinking water PAG was developed based on risks associated with ingesting drinking water contaminated with radionuclides. EPA also considered the potential radiation dose people could receive from various other uses of contaminated water, including showering, bathing, and dishwashing. In the United States, people typically shower, bathe, and wash dishes using the same source of water that they use to drink, but, for the radionuclides of interest, these activities generally represent much smaller risk than drinking contaminated water. Protection of a community's drinking water supply based on assumptions about ingestion will also protect the population from undue risk from contaminated drinking water by other routes of exposure.

⁴ EPA. 2013. Draft PAG Manual for Interim Use and Public Comment. Available online at: <http://www.epa.gov/radiation/docs/er/pag-manual-interim-public-comment-4-2-2013.pdf>.

⁵ EPA. 1999. Cancer Risk Coefficients for Environmental Exposure to Radionuclides. Federal Guidance Report #13. Available online at: <http://www.epa.gov/rpdweb00/docs/federal/402-r-99-001.pdf>.

⁶ Brent, R.L., Frush, D.P., Harms, R.W., and M.S. Linet. 2013. *Preconception and Prenatal Radiation Exposure: Health Effects and Protective Guidance*. National Council on Radiation Protection. Report #174.

⁷ Public feedback on the draft PAG Manual was requested in the Federal Register Notice Vol. 78, No. 72, p. 22257, April 15, 2013.

4.0 RATIONALE FOR A TWO-TIER DRINKING WATER PAG

In addition to a PAG of 500 mrem for the general population (i.e., anyone over age 15, excluding pregnant women and nursing women), EPA proposes establishing a more stringent PAG of 100 mrem to inform protective actions for pregnant women, nursing women and children. Fetuses, infants and children are at greater risk from radiological exposures than adults. This is due to the greater sensitivity of the developing body to the potential harmful effects of radiation and the longer dose commitment period for the longer-lived radionuclides that clear slowly from the body; a newborn that ingests radioactive material in water might be subject to the effects of that radiation for a longer period of time than an adult.

There are precedents for establishing a second, more protective threshold for radiological risks for younger members of the population due to the greater radiosensitivity of children versus adults. Following the Fukushima nuclear plant releases in 2011, the Japanese authorities set an emergency drinking water standard for infants that was one-third of the value for adults.⁸

PAGs and other guidance materials established by FDA for thyroid blocking with potassium iodide⁹ and for ingestion of food¹⁰ both include separate thresholds for more sensitive age groups.

Fetuses, infants and children are not a homogenous group. There are considerable differences in the transmission of radiological drinking water contaminants to a fetus via the placenta, to an infant via formula, and to a child via direct consumption. There also is considerable variation in the sensitivities of various organs to radiological threats in developing bodies. Nevertheless, for the sake of making clear and executable decisions in the intermediate phase of emergency response, EPA proposes a single PAG for these more sensitive members of the population. Keeping PAGs relatively simple helps to minimize confusion during their implementation. Therefore, DRLs provided in Section 7.0 were selected by assessing risks to all age groups and choosing the most conservative concentration to the most sensitive age group.

4.1 Rationale for selection of PAG values

The PAG of 500 mrem for the general population is consistent with the FDA food PAG¹¹

⁸ World Health Organization (WHO). 2011. FAQs: Japan nuclear concerns. Page 9, water contamination. September 2011. Available online at: <http://www.who.int/hac/crises/jpn/faqs/en/index8.html>.

⁹ FDA. 2001. *Guidance: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies*. Available online at: <http://www.fda.gov/downloads/Drugs/.../Guidances/ucm080542.pdf>.

¹⁰ FDA. 1998 *Accidental Radioactive Contamination of Human Foods and Animal Feeds: Recommendations for State and Local Agencies*. <http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>

¹¹ FDA. 1998 *Accidental Radioactive Contamination of Human Foods and Animal Feeds: Recommendations for State and Local Agencies*. <http://www.fda.gov/downloads/MedicalDevices/.../UCM094513.pdf>

since many of the considerations for a food PAG also apply to drinking water. It is also consistent with the guidance value of 500 mrem over one year established by the Department of Homeland Security as an intermediate-level PAG for drinking water interdiction.¹²

A PAG of 100 mrem provides the most sensitive members of the population a reasonable level of protection from exposure to radioactivity in drinking water following a radiological incident. That value is comparable to the current public radiation protection standard of 100 mrem per year effective dose, as set forth in Nuclear Regulatory Commission (NRC) regulations (i.e., 10 CFR Part 20.1301). The International Commission on Radiation Protection¹³ recommends reference levels in the range of 20 to 100 mSv (2,000 to 10,000 mrem) for protection of human health in emergencies, and in the range of 1 to 20 mSv (100 to 2,000 mrem) for occupational exposure, exposure by caregivers, or residential radon exposure. EPA's proposed drinking water PAGs are at the lower end of the latter range.

Following the Fukushima nuclear plant releases in 2011, there was concern about levels of radioactive Iodine-131 (I-131) in drinking water. The Japanese authorities applied a two-tier set of provisional emergency standards to I-131 in water: 300 Bq/L (about 8,100 pCi/L) for adults, and 100 Bq/L (about 2,700 pCi/L) for infants (specifically for drinking water used to prepare baby formula). According to informational materials assembled by the World Health Organization in the wake of the incident,¹⁴ these emergency drinking water standards were provisional regulation values established by the Japanese Food Sanitation Act, as indicated by the Nuclear Safety Commission of Japan. These standards were precautionary and took international guidance into consideration, including recommendations of the International Atomic Energy Agency and the International Commission on Radiological Protection. The infant standard, furthermore, was equivalent to the international guideline set by Codex Alimentarius¹⁵ for infant food.

Under the Safe Drinking Water Act (SDWA), the Agency established maximum contaminant levels (MCLs) for radiological contaminants in drinking water. The National Primary Drinking Water Regulations (NPDWR) for radionuclides, set forth in 40 CFR 141, effectively adopt a dose-based limit of 4 mrem/yr for beta particle and photon radioactivity. These requirements are based on lifetime exposure criteria, which assume 70 years of continued exposure to contaminants in drinking water. The Agency determined that it is not appropriate to base protective actions during short-term emergency incidents on lifetime exposure criteria. While the SDWA framework is appropriate for day-to-day normal operations, it does not provide the necessary tools to

¹² See Table 1 in 73 FR 45029, <http://www.gpo.gov/fdsys/pkg/FR-2008-08-01/pdf/E8-17645.pdf>.

¹³ International Commission on Radiological Protection (ICRP). 2007. *The 2007 Recommendations of the International Commission on Radiological Protection*, Annals of the ICRP, Volume 37, Nos.2-4, 2007, Publication 103, ISSN 0146-6453, ISBN 978-0-7020-3048-2, pp. 96-98

¹⁴ WHO. 2011.

¹⁵ <http://www.codexalimentarius.org/about-codex/en/>.

assist emergency responders with determining the need for an immediate protective action. However, regardless of the cause of an incident, EPA expects that any drinking water system impacted during a radiation incident will take action to return to compliance with the National Primary Drinking Water Regulation (NPDWR) levels by the earliest feasible time.

5.0 INTERPRETING AND APPLYING THE PAG

The drinking water PAG is intended primarily to guide planning and decision-making efforts by local and state officials, including drinking water providers, during the intermediate phase of a radiological emergency when water supplies are particularly vulnerable to contamination from deposition of radioactive material from the atmosphere. Actions to protect water supplies may be implemented at other levels and at any time following a radiological incident, and even before an anticipated release occurs. The goal is to keep the dose to the public as low as reasonably achievable. Radiation doses should be reduced to below SDWA MCLs as soon as practicable.

5.1 Interpreting the two-tier PAG

EPA is proposing a two-tier PAG: 500 mrem for the general population (anyone over age 15, excluding pregnant women and nursing women) and 100 mrem for pregnant women, nursing women and children.

Authorities have flexibility on how to apply the PAG. In some cases they may find it prudent to use the PAG of 100 mrem as a target for the whole population, while in other circumstances, authorities may find that it makes sense to use both targets simultaneously. For example, emergency managers can use a two-tiered approach to focus on protecting the most sensitive population with limited alternate water resources. If bottled water must be rationed, for example, authorities may make the bottled water available to children, pregnant women and nursing women, and instruct the rest of the population to use a public drinking water supply that will satisfy the 500 mrem PAG.

As stated above, the PAGs are intended as guidance, and local authorities should take into account local circumstances (e.g., incident scope and community needs) when implementing a course of action to protect the public.

5.2 Operationalizing PAGs as Derived Response Levels (DRLs)

The PAG specifies a radiation dose to avoid via drinking water exposure projected over one year. In order to determine whether a PAG should be implemented, authorities will need to establish a relationship between the concentration of one or more radionuclides in a drinking water source and the radiation dose members of the population might experience as a result of drinking contaminated water. Incident-specific factors that may be taken into consideration include:

1. The radionuclides of concern
2. The rate and timing of entry of the radionuclides into a drinking water supply, via atmospheric deposition or by other means

3. The rate of natural attenuation of the radionuclides
4. The estimated potential duration of public exposure to contaminated drinking water
5. The estimated daily consumption of contaminated drinking water

Those responsible for implementing PAGs will need to convert PAGs into Derived Response Levels (DRLs) in units of Bq/L or pCi/L. Section 7.0 of this document provides DRLs and explains how they can be calculated. Selected dose conversion factors and standard estimates of daily drinking water consumption for various age groups are also provided, along with references to informational resources.

While the PAG Manual is primarily for advance planning, there are specific radionuclides, including cesium-137 (Cs-137), iodine-131 (I-131) and strontium/yttrium-90 (Sr-90/Y-90) that are of particular interest for radiological incident scenarios where drinking water sources might be contaminated. Section 7.0 presents default DRLs for these radionuclides to aid emergency managers in making water restriction decisions involving these contaminants. DRLs for these radionuclides are presented as examples for purpose of illustration. If other radionuclides are present, DRLs should be calculated using the same methodology, as discussed in Section 7.0.

5.3 Practical Considerations

After deposition has ended, radionuclide concentrations present in a water supply may decline at rates determined by half-lives of the individual nuclides, or may decline faster by dilution with uncontaminated water, or may even increase after rainfall events. The concentration of radionuclides in drinking water as a function of time after the incident can be measured, estimated or modeled based on knowledge of the incident, including radionuclide sources and the properties of the drinking water supply. Such estimates should be validated by monitoring or sampling, as discussed in Section 6.1.

Unlike naturally-occurring radionuclide contamination of drinking water from minerals present in geological formations, for a radiation release incident, ground water supplies are expected to be less vulnerable to contamination than surface water supplies, but this should be confirmed by monitoring or sampling. The potential for ground water to become contaminated will greatly depend on whether the ground water resource is close to the surface or is from a deep aquifer bounded by an aquitard, as well as on rainfall rate and the composition of the overlying soil (which will affect the rate at which contaminants deposited on soil will migrate to the ground water resource).

A PAG is intended as a point of reference to aid emergency response managers in their decision-making. After a particular situation stabilizes and becomes more clearly defined, local authorities may wish to modify the PAG level they consider to be appropriate in order to implement longer-term dose reduction strategies. Decision makers may also want to consider lower dose levels for a drinking water PAG, depending on available resources and needs of an individual community. EPA expects

that any drinking water system adversely impacted during a radiation incident will take action to return to compliance with NPDWR levels as soon as practicable.

Section 6.3 discusses actions that authorities can take to minimize radiation doses. Because radionuclides decay over time, early interventions such as restricting use of contaminated water immediately after the incident may be most effective in reducing radiation dose to the population. Such decisions may need to be made based on limited information. Authorities may find it prudent to take such action even before field sample measurements or modeled estimates of radiation dose have been calculated and validated.

6.0 PLANNING AND TAKING ACTION

This section discusses actions that state and/or local authorities and drinking water utilities can take to protect the public in the event that a water supply is affected by a significant radiological contamination incident. This section does not constitute a complete handbook for radiological emergency response, but it describes considerations that can be included in comprehensive emergency planning at the state, local and utility level. Actions that public authorities and drinking water providers should take include water monitoring (described in Section 6.1), public notification (described in Section 6.2), and mitigation measures to protect the water supply and the water-consuming public (described in Section 6.3).

Preventive action, such as temporary closure of water system intake valves to prevent a contaminant plume from entering the system, may be taken in advance of an anticipated release; it is not necessary to wait until drinking water contamination is detected. Emergency response plans need to consider whether sufficient storage capacity is available to support the community's fire suppression and sanitation needs while the intake valves are closed.

Emergency planning provides the opportunity to develop state, local and utility-specific plans and implementation procedures that reflect the unique needs of a particular community. Advance planning can provide clarity and facilitate the decision-making process during a radiological emergency.

6.1 Monitoring and Characterization of Contaminants

A comprehensive radiological surveillance program to monitor concentrations of radionuclides of interest in both source water and finished drinking water will provide an indication of whether any adjustments are necessary or if the actions being taken are effective.

The NPDWR for radionuclides requires community water systems (CWSs) to conduct monitoring at each entry point to the distribution system to ensure that every customer's water does not exceed the MCLs for radionuclides.¹⁶ All CWSs are required to monitor

for gross alpha, radium-226/228, and uranium. In addition, CWSs designated by the state as “vulnerable”¹⁷ and those using waters “contaminated”¹⁸ by effluents from nuclear facilities must also conduct monitoring for beta particle and photon radioactivity. If a water system is directed by the primacy agency to collect samples for compliance purposes, approved analytical methods must be used.

In the event of a radiological contamination incident, state officials may require public water systems to immediately collect additional samples for radionuclides, including beta particle and photon activity. However, EPA recognizes that during an emergency situation it may be necessary to identify alternative sampling and analytical approaches to obtain data to inform short-term actions by emergency response personnel. Many states have established Radiological Emergency Preparedness programs designed to guide sample collection and analysis and to advise emergency managers in a radiological emergency. Additionally, the Federal Radiological Monitoring and Assessment Center (FRMAC) can deploy monitoring and sampling field teams and provide dose assessment expertise to assist states and local communities in responding to an emergency. See the National Response Framework, Nuclear/Radiological Incident Annex¹⁹ for information on roles and capabilities.

EPA provides rapid laboratory analysis methods for selected radionuclides to expedite the analytical turnaround time while simultaneously meeting measurement quality objectives.²⁰ Challenges may arise from variability in environmental matrices. Advance emergency planning can help to achieve sample representativeness and homogeneity relative to routine samples.

If members of the public are served by drinking water from household cisterns or private wells, local officials should consider how monitoring should be undertaken to determine levels of target radionuclides and assess the risks posed to these populations.

6.2 Public Notification

An emergency response plan should include a strategy for keeping the community informed of the actions being taken by authorities and clearly delineated roles and responsibilities of local officials and emergency responders. This includes communicating to customers of CWSs and (if applicable) to those who rely on household cisterns and private wells. It is critical for water utilities to participate in the emergency response planning activities.

¹⁶ For more information about monitoring requirements for the Radionuclides Rule see the “Radionuclides Rule: A Quick Reference Guide” (EPA 816-F-01-003, June 2001) or “Implementation Guidance for Radionuclides” (EPA 816-F-00-002, March 2002).

¹⁷ For more information see 40 CFR 141.26(b)(1).

¹⁸ For more information see 40 CFR 141.26(b)(2).

¹⁹ Document is available online at: <http://www.fema.gov/media-library/assets/documents/25554>

²⁰ EPA. 2014a. Rapid Radiochemical Methods Applicable to Selected Radionuclides for Environmental Remediation Following Radiological Incidents. Third Edition. Front matter available online at: <http://www.epa.gov/narel/Docs/Preface%20to%203rd%20Edition%20%28Online%29%2004-16-14.pdf>. Rapid methods are available online at: http://www.epa.gov/narel/rapid_methods.html

If compliance monitoring indicates that contamination levels exceed the MCL for any radionuclide, water systems are required to issue public notice on a “Tier 2” time frame (i.e., as soon as practical, but no later than 30 days after the system learns of the violation). However, States may determine that the notification requirement should be elevated to a “Tier 1” Public Notification (i.e., as soon as practical, but no later than 24 hours) based on a significant potential for serious adverse effects on human health due to short-term exposure.²¹

During a response to a radiological event, water systems may have difficulty with issuing public notifications in addition to managing the response to the contamination event. The state may issue public notification on behalf of the water system (40 CFR 141.210(a)). This would allow the state to deliver a consistent message to all affected customers and allow the system to concentrate its efforts on returning to operation or returning to compliance in the event of a radionuclides MCL violation. For more information see the Revised Public Notification Handbook (EPA 816-R-09-013, March 2010).

State and local authorities should be proactive in communicating about risks and uncertainties and providing clear instructions to the public. For any incident response requiring coordinated federal support, refer to the National Response Framework and Emergency Support Function 15, External Affairs Annex, for roles and response protocols.

6.3 Additional Actions to Reduce Levels of Contamination

In the initial phase following a radiological incident, officials should take reasonable precautionary measures to protect water supplies as soon as notification of a radiological release or impending release is received. As data are obtained from monitoring programs (including sampling and analysis of water upstream and downstream of a water system intake structure and within the distribution system) and observed concentrations are benchmarked against derived response levels (DRLs) calculated from the PAGs, officials can make informed decisions about the need to implement protective actions in the intermediate phase. Water system officials should be in close communication with their primacy agency (e.g., state/county regulators) prior to taking protective actions.

Options available to water systems to reduce radiation dose to drinking water customers during the intermediate phase include applying treatment technologies, relying on back-up storage, blending water, accessing alternative water supplies, and rationing of uncontaminated water. Examples of these options are described briefly below. Technical and economic burden on smaller systems may be reduced by pooling resources with other water systems (e.g., establishing interconnections, sharing technical and operator staff, and sharing of supplies and equipment). As part of

²¹ For more information see 40 CFR 141.202(a), Table 1(9), Special public notices: Occurrence of a waterborne disease outbreak or other waterborne emergency.

emergency planning efforts, local officials should consider the possibility of temporary rationing of uncontaminated or treated water if supplies are inadequate to meet normal demand.

Many of these options require advanced planning. Guidance on developing emergency drinking water supplies is available from EPA.²² The Centers for Disease Control and Prevention also provide resources and guidance for establishing emergency water supplies and communicating water advisories to the public.²³

6.3.1 Treating Contaminated Water

Systems can treat contaminated water to reduce elevated radionuclide levels. Four treatment technologies are classified by EPA as Best Available Technologies (BATs) for removing radionuclides from drinking water: coagulation/filtration, ion exchange, lime softening and reverse osmosis. EPA has also listed these BATs as Small System Compliance Technologies (SSCTs) for radionuclides treatment, along with less commonly used techniques such as green sand filtration, co-precipitation with barium sulfate, electrodialysis/electrodialysis reversal, pre-formed hydrous manganese oxide filtration and activated alumina. Further information on radionuclide treatment options is available from EPA.²⁴

Removal efficiency for specific radionuclides will vary across available technologies and may depend on technology-specific parameters (e.g., ion exchange effectiveness depends on pH, resin selected and presence of other ions). In addition, liquid and solid treatment residuals with elevated radiation levels may have special disposal requirements. Disposal options may vary from one jurisdiction to another, and may depend on the type, concentration and volume of residuals. Further information on residual disposal considerations is available from EPA.²⁵

6.3.2 Temporarily Closing Intake Valves

If the deposition of radionuclides into a river is limited in duration, only a portion of the water may become contaminated. A water system with enough storage capacity can temporarily close its intake valves and allow the contaminants to flow past the intake to prevent contamination from entering the distribution system.

²² EPA. 2011b. *Planning for an Emergency Drinking Water Supply*. EPA 600/R-11/054, June 2011.

²³ CDC. 2014. Drinking Water Advisory, Planning, & Emergency Response Resources. Available on the Internet at: <http://www.cdc.gov/healthywater/emergency/drinkingwateradvisory.html>. Last updated December 2, 2014.

²⁴ EPA. 2015a. Radionuclides in Drinking Water -- Compliance Options: Treatment Technology Descriptions. Available on the Internet at: <http://cfpub.epa.gov/safewater/radionuclides/radionuclides.cfm>. See also EPA. 2002a. *Radionuclides in Drinking Water: A Small Entity Compliance Guide*. EPA 815-R-02-001, 2002. (http://www.epa.gov/safewater/radionuclides/pdfs/guide_radionuclides_smallsystems_compliance.pdf).

²⁵ EPA. 2006a. *A System's Guide to the Management of Radioactive Residuals from Drinking Water Treatment Technologies*. EPA 816-F-06-012, August 2006. See also EPA. 2006b. *A System's Guide to the Identification and Disposal of Hazardous and Non-Hazardous Water Treatment Plant Residuals*. EPA 816-F-06-011, August 2006.

If stored water supplies are not sufficient to meet community fire suppression and sanitation needs while intake valves are closed, the system could take other actions discussed in this section, including supplementing water supplies with alternate sources or implementing water use restrictions.

6.3.3 Establishing Interconnections to Neighboring Systems

If the water system is part of a larger, regional supply system, existing interconnections to an uncontaminated neighboring water supply could be activated. It might also be possible to construct temporary pipelines on an impromptu basis.

If this option is implemented, steps should be taken to prevent backflow from the contaminated system. Care will also need to be taken to ensure that the supply of water and treatment capacity at the uncontaminated system will adequately serve the larger population.

6.3.4 Blending Water Sources

If a source of uncontaminated water is available, a water system may choose to blend water from contaminated and uncontaminated sources of drinking water. The water may be blended using storage tanks or a common header to allow for complete mixing prior to distribution to customers.

6.3.5 Importing Water in Tanker Trucks

Under some circumstances (e.g., difficult terrain, urgent need), it may be more efficient or expedient to temporarily transport clean water by truck, rail or barge to distribution centers in the affected community than to lay down pipelines. State and local departments of public health, as well as emergency management agencies, typically have standards and requirements related to hauling water. Water systems would benefit from having procedures for importing water in tanker trucks documented in an emergency response plan. All water systems importing water by tanker should verify that their plan adheres to state and local requirements. If the water system's distribution system is not being used to provide the imported water, the needs of residents with limited transportation options and physical disabilities should be taken into account when selecting locations for distribution centers. The availability of suitable transport vehicles may limit use of this option.

6.3.6 Importing Bottled Water

Providing bottled water to the affected community is another possible option during an emergency situation. The water may come from a nearby water system or from a water bottling company. This option may be cost-effective during an emergency if water is needed quickly and if the length of the emergency does not require long-term action, such as the construction of an interconnecting pipe.

7.0 DERIVED RESPONSE LEVELS (DRLS)

EPA developed the radionuclide-specific DRLs by calculating the radionuclide concentrations in drinking water that would result in projected radiation doses of 100 and 500 mrem dose, assuming one year of continuous exposure and average drinking water intake rates for children and adults.

Several considerations should be kept in mind when using these pre-calculated DRLs. The DRLs presented in Table 1 are calculated on the assumption that each radionuclide is the only radionuclide present in drinking water. DRLs are additive. In situations where multiple radionuclides are present, DRLs should be combined using a sum of fractions approach to ensure that the projected dose does not exceed the PAG of 100 or 500 mrem. (An example calculation is provided in Section 7.1.) Table 1 does not present DRLs for all radionuclides that may occur in drinking water following a contamination incident.

These DRLs were calculated using a simplifying and conservative assumption that radionuclide levels will remain constant over the course of one year. This provides an added level of protection in light of the many unknowns involved in an emergency. In fact, after the initial deposition event has occurred, concentrations may decline at rates determined by the half-lives of individual isotopes, or decline faster due to dilution with uncontaminated water, or could even increase after rainfall or subsequent deposition events. Some nuclides, like I-131, have half-lives measured in days, while others, like Cs-137, have half-lives measured in years. Early exceedance of the DRL does not preclude the possibility that doses will stay below PAGs as radionuclide concentrations in water decline by a combination of radioactive decay and natural attenuation. If the concentrations of radionuclides do not exceed DRLs over the course of one year, doses will remain below the PAG.

Table 1. Derived response levels (DRLs)²⁶ -- drinking water concentrations corresponding to specified doses (mrem) of select radionuclides, assuming one year of exposure at constant levels²⁷

	DRLs for pregnant women, nursing women and children age 15 and younger – 100 mrem dose	DRLs for adults (excluding pregnant women and nursing women) – 500 mrem dose

²⁶ Values provided in this table have been rounded.

²⁷ The calculated values provided in this table are intended to illustrate the methodology and conservative assumptions EPA believes are adequate to provide a reasonable level of protection to sensitive populations. Additional information including updated dose conversion factors, calculation methodologies as well as other comprehensive information regarding DRL development will be appended to the FRMAC Assessment Manual.

Sr-90/Y-90 ²⁸	1,000 pCi/L	7,400 pCi/L
Cs-137	6,140 pCi/L	16,570 pCi/L
I-131	1,310 pCi/L	10,350 pCi/L

The DRLs provided in Table 1 were derived by calculating life stage-specific DRLs (as described in section 7.2) for six different ages (Infant, 1, 5, 10, 15, and adults). For the most sensitive life-stages concentrations of individual radionuclides yielding a 100 mrem dose were calculated for each age group, then the most protective/lowest radioactivity concentration was selected as the DRL for the entire sensitive life-stage group, including pregnant and nursing woman. The calculated values differ across individual life-stages because each age group has a different dose conversion factor and drinking water ingestion rate.

For example, the sensitive life-stage group DRL for I-131 was derived by calculating the concentration of I-131 which yields a 100 mrem dose for each age group. In this case the resulting concentrations were: infants (2,110 pCi/L), 1 yr (1,860 pCi/L), 5 yr (1,310 pCi/L), 10 yr (1,950 pCi/L), and 15 yr (2,410 pCi/L). Since the lowest calculated concentration corresponds to the 5 year old (1,310 pCi/L), this value is the DRL that will be applied to be the most protective for the entire sensitive life-stage group.

7.1 Calculation of DRLs

DRLs may be calculated with the help of the following equations.

The dose (mrem or Sv) due to the ingestion of radionuclide *i* to age group *a* over time period *T* is calculated as follows:

$$D_{iaT} = I_{iaT} \times DCF_{ia}$$

Where:

- D_{iaT} = Dose (in mrem or Sv) due to the ingestion of radionuclide *i* to age group *a* over time period *T*
- I_{iaT} = The total intake of radionuclide *i* for age group *a* (in pCi or Bq) over time period *T*
- DCF_{ia} = The dose conversion factor (also referred to as dose coefficient) for the ingestion of radionuclide *i* in drinking water and age group *a* (in mrem/pCi or Sv/pCi, or mrem/Bq or Sv/Bq). See section 7.4 for guidance on DCFs.

²⁸ Y-90 is a radioactive decay product of Sr-90 and will normally be found alongside Sr-90 in the case of a Sr-90 release; therefore they are treated together. Solubility differences may cause less Yttrium to be present, however it is a conservative assumption to include both in DRLs. When calculating the combined DRL, note that the dose coefficients (see Table 3) are additive.

The quantity of radionuclide i ingested by age group a over a given time period, T , is calculated as follows.

$$I_{iaT} = C_i \times \text{Ing}_a \times T$$

Where:

- I_{iaT} = The total intake of radionuclide i for age group a (in pCi or Bq) over time period T .
- C_i = The concentration of radionuclide i in drinking water (in pCi/L or Bq/L). A simplifying assumption is made that the concentration of the radionuclide is constant over the time period T .
- Ing_a = The daily ingestion rate of water for age group a , in L/day. See Section 7.3 for guidance on daily water ingestion rates.
- T = The time period that the population is drinking contaminated water (days). In this analysis, the time period of interest is 365 days.

For each age group a and radionuclide i , substituting the applicable PAG for the dose D_{iaT} and then solving for C_i yields the applicable DRL.

For example, the DRL for Iodine-131 for an adult is calculated as follows:

$$\begin{aligned} \text{DRL} &= \text{PAG} / (\text{Ing}_a \times T \times \text{DCF}_{ia}) \\ \text{DRL} &= 500 \text{ mrem} / (1.643 \text{ L/day} \times 365 \text{ days} \times 8.05 \text{ E-05 mrem/pCi}) \\ &= 500/4.83 \text{ E-02} \\ &= 10,352 \text{ pCi/L} \end{aligned}$$

Which is best rounded to 10,350 pCi/L considering the uncertainties.

7.2 Combining DRLs for Multiple Radionuclides

If multiple radionuclides are present in the water supply, then it is recommended that the obtained concentrations of each radionuclide be divided by the provided DRL values. This provides a fraction of the allowed concentration (and the projected dose) for each radionuclide. If the sum of the fractions is less than 1, the total dose is assumed to be below the PAG values. Emergency response personnel may need to calculate the sum of fractions on an ongoing basis, as the concentrations of individual radionuclides may change over time. The sum of the fractions is expressed as follows:

$$F = \sum (C_i / \text{DRL}_i)$$

Where:

F = sum of the fractions

C_i = the concentration of radionuclide i in the water supply (pCi/L or Bq/L)

DRL_i = derived response level for the i^{th} radionuclide (pCi/L or Bq/L)

For example, if Sr-90/Y-90 and Cs-137 are the only radionuclides present in the drinking water, and Sr-90/Y-90 are present at 1,540 pCi/L and Cs-137 is present at 10,600 pCi/L, the combined dose exceeds the PAG of 100 mrem for fetuses, infants, and children:

$$\begin{aligned} F &= \sum (C_i / DRL_i) \\ &= (1,540 \text{ pCi/L} / 1,000 \text{ pCi/L}) + (10,600 \text{ pCi/L} / 6,140 \text{ pCi/L}) \\ &= 1.54 + 1.73 \\ &= 3.27 \end{aligned}$$

$3.27 > 1$, so the PAG is exceeded.

The same concentrations do not exceed the PAG of 500 mrem for adults:

$$\begin{aligned} F &= \sum (C_i / DRL_i) \\ &= (1,540 \text{ pCi/L} / 7,415 \text{ pCi/L}) + (10,600 \text{ pCi/L} / 16,570 \text{ pCi/L}) \\ &= 0.21 + 0.64 \\ &= 0.85 \end{aligned}$$

$0.85 < 1$, so the PAG is not exceeded.

7.3 Water Ingestion Rates

Table 2 presents mean values for tap water consumption taken from the CD supplement to FGR-13.²⁹ Other sources of estimated drinking water ingestion rates are available (e.g., EPA's *Exposure Factors Handbook*³⁰), but the ingestion rates presented in FGR-13 were specifically designed with corresponding age ranges to be used in conjunction with other data from FGR-13. Values are provided for males and females in various age groups. Since the ingestion rates for males are higher (and therefore more conservative) than those for females, EPA elected to use the intake values for males to represent each age group in the calculation of DRLs in Table 1. In addition, for the calculation of the adult DRL, EPA made the conservative assumption that the ingestion rate would be assigned the highest value within the adult category, the 50 year old

²⁹ EPA. 2002b. Federal Guidance Report 13. Cancer Risk Coefficients for Environmental Exposure to Radionuclides: CD Supplement, EPA-402-C-99-001, Rev. 1.

³⁰ EPA. 2011a.

male, at an estimated 1.643 L/day.

Table 2. Mean Drinking Water Ingestion Rates from FGR-13

Age (years)	Tap Water (L/day)	
	Male	Female
0	0.191	0.188
1	0.223	0.216
5	0.542	0.499
10	0.725	0.649
15	0.900	0.712
20	1.137	0.754
50	1.643	1.119
75	1.564	1.179

Source: CD Supplement to FGR-13, Table 3.1.

7.4 Dose Coefficients, or Dose Conversion Factors (DCF) (Sv/Bq Ingested)

The effective whole body dose per Bq ingested of various radionuclides in water, for various age groups, can be found on the CD supplement to FGR-13.³¹ These DCF values apply to both males and females. Table 3 presents DCFs for a few representative radionuclides of interest, converted to U.S. units for convenience.

Table 3. Dose Conversion Factors³²

Age	DCFs (mrem per pCi ingested), from FGR-13			
	Sr-90	Y-90	Cs-137	I-131
Infant (100 day old)	8.40E-04	1.16E-04	7.79E-05	6.82E-04
1 year old	2.68E-04	7.41E-05	4.58E-05	6.62E-04

³¹ EPA. 2002

³² The DCFs in this table show the variation across age groups and nuclides and are provided to illustrate the conservative methodology and assumptions EPA believes are adequate to provide a reasonable level of protection to sensitive populations. Additional information including updated dose conversion factors, calculation methodologies as well as other comprehensive information regarding DRL development will be appended to the FRMAC Assessment Manual.

5 year old	1.73E-04	3.69E-05	3.58E-05	3.83E-04
10 year old	2.21E-04	2.18E-05	3.75E-05	1.94E-04
15 year old	2.92E-04	1.24E-05	4.95E-05	1.27E-04
Adult	1.02E-04	9.94E-06	5.02E-05	8.05E-05

Source: CD Supplement to FGR-13.

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]; Burneson, Eric[Burneson.Eric@epa.gov]
From: Christ, Lisa
Sent: Thur 4/16/2015 7:59:19 PM
Subject: RE: PAGs project plan check-in

I inadvertently deleted the reference to the 100 mrem PAG for kids in the draft FRN section C.

I can send a revised version or you can add the language back in during your review - just let me know.

Lisa

From: DeCair, Sara
Sent: Thursday, April 16, 2015 3:50 PM
To: Christ, Lisa
Cc: Veal, Lee; Perrin, Alan; Hernandez-Quinones, Samuel; Ellis, Jerry; Burneson, Eric
Subject: RE: PAGs project plan check-in

Lisa,

Fabulous! This will keep me busy for a few – thank you! I will also send the proposal to our OGC rep now and can then make sure our ODs have done a heads up to both parts of OSWER before those reviews start. I can facilitate that and OHS, no problem.

Jessica and I will get back to you on Comms and more Answers for the Q and A's soon. Again, thank you -- I'm really excited to get this up and out, as you know, so I'll touch base on schedule next week.

Sara

From: Christ, Lisa
Sent: Thursday, April 16, 2015 3:12 PM
To: DeCair, Sara
Cc: Veal, Lee; Perrin, Alan; Hernandez-Quinones, Samuel; Ellis, Jerry; Burneson, Eric
Subject: RE: PAGs project plan check-in

Hi Sara –

Thanks for providing a revised schedule. I think we may be able to move things a little quicker (hopefully) than you've laid out. We'll do better keeping to this schedule!

Attached are several documents related to the PAG and schedule.

1. Updated PAG proposal chapter (based on PAG subcommittee comments)
2. Comments on the Action Memo
3. Draft OW communication plan
4. Comments on the FRN (note: as of this week there's a new FRN template)
5. Very draft internal Q&As
6. Feedback on the schedule

We intend to send the updated chapter to our OGC reviewer today and request comments by April 30.

Do you need our help coordinating OSWER and/or OHS review?

Thank you for your patience –

Lisa

From: DeCair, Sara
Sent: Monday, April 13, 2015 3:43 PM
To: Christ, Lisa
Cc: Veal, Lee; Perrin, Alan
Subject: PAGs project plan check-in

Lisa,

Lisa,

Lee and I were talking about getting your feeling on the dates for our next several steps on the drinking water PAG proposal. I know Sam's busy with the proposal edits right now, but maybe you can see if you think the months listed in the attached two page plan are achievable, given some unpredictability noted at the bottom.

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I'll be in my office Tuesday through Thursday this week and Lee will be traveling but available if we need to get on a call together. Thank you for any input you have on the timeline!

Sara 202-343-9108

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Thur 4/16/2015 9:05:48 PM
Subject: RE: PAGs project plan check-in
Water PAG FR Notice draft 4-16-2015.docx

Trying again!

This version had both the 100 and 500 mrem. Please review this version.

L

From: DeCair, Sara
Sent: Thursday, April 16, 2015 4:32 PM
To: Christ, Lisa
Subject: RE: PAGs project plan check-in

Oops, that is important! If you have the deleted item handy, will you put it in? I am crunching a huge analysis right now and trying to get done by 6 pm – if not, I can really add it in when I review in a day or two. Thank you!!

From: Christ, Lisa
Sent: Thursday, April 16, 2015 3:59 PM
To: DeCair, Sara
Cc: Veal, Lee; Perrin, Alan; Hernandez-Quinones, Samuel; Ellis, Jerry; Burneson, Eric
Subject: RE: PAGs project plan check-in

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Sara 202-343-9108

To: Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Wed 4/15/2015 9:19:06 PM
Subject: RE: draft Water PAG Action Memo for your input

Hello Jerry – any comments on the memo and/or FRN?

Thanks

Lisa

From: Ellis, Jerry
Sent: Tuesday, April 14, 2015 1:00 PM
To: Christ, Lisa; Hernandez-Quinones, Samuel
Subject: RE: draft Water PAG Action Memo for your input

I will have comments on the action memo.

Jerry L. Ellis, Jr.

Environmental Scientist

U.S. Environmental Protection Agency

Standards and Risk Management Division

Office of Ground Water and Drinking Water

1200 Pennsylvania Ave. (4607M), N.W.

Washington, D.C. 20460

Phone: 202-564-2766

From: Christ, Lisa
Sent: Tuesday, April 14, 2015 7:58 AM

To: Hernandez-Quinones, Samuel; Ellis, Jerry
Subject: RE: draft Water PAG Action Memo for your input

Gentlemen –

I don't think I received any comments from either of you. Did you have any on the action memo?

We also need to provide comments on the draft FRN. Please send your comments for both documents to me by COB tomorrow.

Thanks-

Lisa

From: Christ, Lisa
Sent: Thursday, April 02, 2015 8:43 AM
To: Hernandez-Quinones, Samuel; Ellis, Jerry
Subject: FW: draft Water PAG Action Memo for your input

Please send your comments to me by COB April 8 and I'll compile our comments and send them forward.

L

From: DeCair, Sara
Sent: Wednesday, April 01, 2015 9:42 AM
To: Veal, Lee; Perrin, Alan; Christ, Lisa; Hernandez-Quinones, Samuel; Ellis, Jerry; Wieder, Jessica
Subject: draft Water PAG Action Memo for your input

Good morning all;

I've retooled our 2013 PAG Manual Action Memo to convey our drinking water proposal from our AAs to OP, to OMB, and then eventually up for signature. This memo will go in the FR package and OP will check all their policy review boxes so it's wise to make sure now that we're on track to do all these things.

Some challenges could be introduced by opening this up for intra-Agency reviews and so I've encouraged our ODs to make contact with their OD counterparts to make them aware of the proposal. Our next stop is OGC, for a full review.

Also, this memo says the proposal is for Stan Meiburg's signature, but yesterday we talked about having Ken Kopocis sign the FR Notice of Availability instead. That might be less onerous to get through the process, and at Tier 4, this type of notice is often signed by the AA level since it is not final or binding in any way.

Thoughts? Thank you!

Sara

Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

****new office****

Room 1416 B in WJC West

To: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Tue 4/14/2015 11:57:51 AM
Subject: RE: draft Water PAG Action Memo for your input

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Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

****new office****

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]
From: Christ, Lisa
Sent: Tue 4/14/2015 2:59:04 PM
Subject: RE: PAGs project plan check-in

Hi Sara,

I'll take a look at the dates. I'm in a stakeholder meeting all afternoon today. We plan to have the revised chapter (no substantive changes) and comments on the FRN and action memo to you by the end of this week

Lisa

From: DeCair, Sara
Sent: Monday, April 13, 2015 3:43 PM
To: Christ, Lisa
Cc: Veal, Lee; Perrin, Alan
Subject: PAGs project plan check-in

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Sara 202-343-9108

To: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Thur 4/2/2015 12:42:59 PM
Subject: FW: draft Water PAG Action Memo for your input
PAG Action Memo Water 4-1-2015.docx

Please send your comments to me by COB April 8 and I'll compile our comments and send them forward.

L

From: DeCair, Sara
Sent: Wednesday, April 01, 2015 9:42 AM
To: Veal, Lee; Perrin, Alan; Christ, Lisa; Hernandez-Quinones, Samuel; Ellis, Jerry; Wieder, Jessica
Subject: draft Water PAG Action Memo for your input

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Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

****new office****

Room 1416 B in WJC West

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Mon 3/30/2015 8:54:43 PM
Subject: RE: Agenda Input

thanks

From: Hernandez-Quinones, Samuel
Sent: Monday, March 30, 2015 4:53 PM
To: Christ, Lisa
Subject: Agenda Input

Hi Lisa,

This is my input for the agenda. I will send the Comment document shortly.

=====

Objectives:

Reach Agreement on Changes to Document and prepare for next steps.

Agenda:

- Discuss Comments
- Discuss which materials to be included in the DW PAG Chapter/Section
- Should we expect additional comments from the Sub-Committee (FDA, NRC, Others?)
- Discuss timing/schedule for next actions?

Main Areas covered in comments:

1. Water & FDA PAGs (Combined?, Complimentary?, 500 vs. 1000 mrem/s)
2. Removing mentions of Japan/Fukushima
3. Removing calculations and concentration derivations from DW PAG Chapter, instead making references to FRMAC
4. Clarification/Additional explanation needed on Calculations to derive concentrations
5. What age-groups to be included in the sensitive lifestages tier, children up to 15 or 18 Yr old.
6. Reasons for Conservative Assumptions
7. Editorial/General Comments

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Mon 3/23/2015 1:42:26 PM
Subject: RE: Cmts due tomorrow: Water PAG proposal

Hi Sara –

Please send us the interagency comments on the water PAG so we can begin to assess them before our 3/31 meeting.

Thanks-

Lisa

From: DeCair, Sara
Sent: Tuesday, March 17, 2015 2:46 PM
To: Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; Carlos.Corredor@Hq.Doe.Gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; john.mackinney@dhs.gov; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; michael.howe@fema.dhs.gov; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; paul.ward@fema.dhs.gov; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
Cc: Hernandez-Quinones, Samuel; Christ, Lisa; Ellis, Jerry
Subject: Cmts due tomorrow: Water PAG proposal

Hi all; just a quick reminder that we hope to hear from you by the end of the day tomorrow with your feedback on the water proposal. Please let me know right away if you have any concerns, and I look forward to seeing what you think!

Sara

From: DeCair, Sara

Sent: Tuesday, March 03, 2015 2:16 PM

To: Amy Doll; 'Andrew.Wallo@eh.doe.gov'; 'asa4@cdc.gov'; 'ben.cacioppo@dtra.mil'; 'Carlos.Corredor@Hq.Doe.Gov'; 'Edward.Regnier@hq.doe.gov'; 'John.Jensen@dm.usda.gov'; john.mackinney@dhs.gov; 'john.madrid@dtra.mil'; 'lee.a.nickell@navy.mil'; 'lodwick.jeffrey@dol.gov'; 'michael.howe@fema.dhs.gov'; 'Michael.Noska@fda.hhs.gov'; 'Patricia.Milligan@nrc.gov'; 'paul.ward@fema.dhs.gov'; 'ricardo.a.reyes@us.army.mil'; siddhanti@endyna.com; 'tdkraus@sandia.gov'; Veal, Lee; Wieder, Jessica; 'william.cunningham@nist.gov'

Cc: Hernandez-Quinones, Samuel; Christ, Lisa; Ellis, Jerry

Subject: Water PAG proposal: review by Mar. 18th

PAGs Subcommittee;

We'd like to share a copy of our draft drinking water PAG language for your review. Since this material is still pre-decisional, we request that you do not circulate it beyond the FRPCC PAGs subcommittee. Please contact me for any further guidance, if needed. This document will serve as our Federal Register proposed language and you can see that it provides a lot of explanatory text. After we receive and address public comments, the appropriate language will be used as our Water chapter in a final PAG Manual.

We encourage you to send us feedback on content, wording, and the methods within the next two weeks. **Your comments for this round of review are due Wed., Mar. 18, 2015.**

Our contractor, EnDyna, will collect and organize your comments and we'll run an updated version past you before we complete internal EPA and legal reviews. This won't be your last chance to provide input, though, since we will have a follow up discussion with you about the FR Notice and the Rollout Plan. Afterwards, there will be the OMB interagency review cycle with your agencies.

Thank you in advance for your thoughtful input. Please do write or call if you have any questions. Talk to you soon!

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<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

****new office****

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]
From: Christ, Lisa
Sent: Mon 3/23/2015 4:58:40 PM
Subject: RE: Cmts due tomorrow: Water PAG proposal

Thanks Sara –

We'll take a look at the comments in preparation for the 3/31 meeting.

See y'all then-

Lisa

From: DeCair, Sara
Sent: Monday, March 23, 2015 10:47 AM
To: Christ, Lisa
Cc: Hernandez-Quinones, Samuel; Ellis, Jerry; Veal, Lee; Perrin, Alan
Subject: Re: Cmts due tomorrow: Water PAG proposal

Lisa,

Of course, here are the comments I received. I decided it wasn't voluminous enough to warrant having EnDyna do a compilation, but let me know if you think that would be helpful. They usually do either a spreadsheet of comments or one merged Word version with all the comments. I think we can just incorporate most of the comments without too much trouble.

I'm out the rest of this afternoon but will be in the office tomorrow, Tuesday, so do call or write if you need anything. Thanks!

Sara

From: Christ, Lisa

Sent: Monday, March 23, 2015 9:42 AM
To: DeCair, Sara
Cc: Hernandez-Quinones, Samuel; Ellis, Jerry
Subject: RE: Cmts due tomorrow: Water PAG proposal

Hi Sara –

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'Iodwick.jeffrey@dol.gov'; 'michael.howe@fema.dhs.gov'; 'Michael.Noska@fda.hhs.gov';
'Patricia.Milligan@nrc.gov'; 'paul.ward@fema.dhs.gov'; 'ricardo.a.reyes@us.army.mil';
siddhanti@endyna.com; 'tdkraus@sandia.gov'; Veal, Lee; Wieder, Jessica;
'william.cunningham@nist.gov'

Cc: Hernandez-Quinones, Samuel; Christ, Lisa; Ellis, Jerry

Subject: Water PAG proposal: review by Mar. 18th

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Sara D. DeCair

<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

****new office****

Room 1416 B in WJC West

To: Ellis, Jerry[Ellis.Jerry@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Mon 3/16/2015 3:25:09 PM
Subject: RE: Draft DW PAG Communications Plan
DRAFT Drinking Water PAG Communications Plan _lc.doc

Hi Jerry –

Attached are my comments on the communication plan. I'd like to get your thoughts on additional messages.

Thanks-

Lisa

From: Ellis, Jerry
Sent: Tuesday, March 03, 2015 10:02 AM
To: Christ, Lisa; Hernandez-Quinones, Samuel
Subject: Draft DW PAG Communications Plan

Hi Lisa and Sam:

Please review this plan and send me written edits/comments. After I get a good Comm Plan, I will draft the fact sheets and Q&A documents.

FYI- Giselle has informed me that her review time is about three weeks which includes Peter G's signature if we only have a comm plan, fact sheet and Q&A document. More time would be involved if we update the OGWDW website.

Jerry L. Ellis, Jr.

Environmental Scientist

U.S. Environmental Protection Agency

Standards and Risk Management Division
Office of Ground Water and Drinking Water
1200 Pennsylvania Ave. (4607M), N.W.
Washington, D.C. 20460
Phone: 202-564-2766

To: DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]
From: Christ, Lisa
Sent: Tue 3/3/2015 7:05:52 PM
Subject: RE: quick review: Water chapter to Subcmte

Hi Sara,

We're comfortable with your edits to the document and have no comments to the note below to the subcommittee.

Thanks-

Lisa

From: DeCair, Sara
Sent: Friday, February 27, 2015 4:03 PM
To: Veal, Lee; Perrin, Alan; Christ, Lisa; Hernandez-Quinones, Samuel; Ellis, Jerry; Wieder, Jessica
Subject: quick review: Water chapter to Subcmte
Importance: High

Draft note to the Subcmte with attached chapter for their review. FYI in the chapter, I deleted some mentions of effective or whole body dose to simplify nomenclature and added age groups to the water intakes table, bolding the ones we used for the DRL calculations. I fixed just a couple typos and reconfirmed the math. Please let me know early next week if you see any changes needed in the chapter or this note, and I can send it out ASAP!

Sara

PAGs Subcommittee;

We'd like to share a copy of our draft drinking water PAG language for your review. This document will serve as our Federal Register proposed language and you can see that it provides a lot of explanatory text. Once we receive and address public comments, the appropriate language will be used as our Water chapter in a final PAG Manual.

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<http://www.epa.gov/radiation/rert/pags.html>

202-343-9108

****new office****

Room 1416 B in WJC West

To: Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Tue 2/24/2015 6:23:17 PM
Subject: FW: Rads PAG revised chapter
[2-23-15 Draft Drinking Water PAG track change.docx](#)
[2-23-15 Draft Drinking Water PAG.docx](#)

From: Christ, Lisa
Sent: Monday, February 23, 2015 11:27 AM
To: Edwards, Jonathan
Cc: Hernandez-Quinones, Samuel; DeCair, Sara; Veal, Lee; Oshida, Phil; Burneson, Eric
Subject: FW: Rads PAG revised chapter

Hi Jon,

We appreciate your patience...Attached is the revised rads PAG proposal for review by the interagency PAG subcommittee. In addition, I've attached a redline-strikeout version that shows Eric and Peter's comments on the previous draft. Let us know if you have any questions or concerns. I anticipate the subcommittee will have comments questions too.

Thanks-

Lisa

~~~~~  
Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW  
Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

**To:** Oshida, Phil[oshida.phil@epa.gov]  
**Cc:** Burneson, Eric[burneson.eric@epa.gov]; Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Mon 2/23/2015 4:21:31 PM  
**Subject:** Rads PAG revised chapter  
[2-23-15 Draft Drinking Water PAG track change.docx](#)  
[2-23-15 Draft Drinking Water PAG.docx](#)

Hi Phil-

Attached is the revised rads PAG proposal for review by the interagency PAG subcommittee. In addition, I've attached a redline-strikeout version that shows Eric and Peter's comments on the previous draft. Please forward to Jon Edwards.

Thanks-

Lisa

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

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1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: Edwards, Jonathan[Edwards.Jonathan@epa.gov]
Cc: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]; Oshida, Phil[oshida.phil@epa.gov]; Burneson, Eric[burneson.eric@epa.gov]
From: Christ, Lisa
Sent: Mon 2/23/2015 4:27:24 PM
Subject: FW: Rads PAG revised chapter
[2-23-15 Draft Drinking Water PAG track change.docx](#)
[2-23-15 Draft Drinking Water PAG.docx](#)

Hi Jon,

We appreciate your patience...Attached is the revised rads PAG proposal for review by the interagency PAG subcommittee. In addition, I've attached a redline-strikeout version that shows Eric and Peter's comments on the previous draft. Let us know if you have any questions or concerns. I anticipate the subcommittee will have comments questions too.

Thanks-

Lisa

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Lisa Christ, Chief

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Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW  
Washington, DC 20460-0001  
phone: 202.564.8354  
fax: 202.564-3760

Mail Code: 4607M



**To:** Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]  
**Cc:** Ellis, Jerry[Ellis.Jerry@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Wed 2/18/2015 7:03:24 PM  
**Subject:** FW: PAG suggested edits  
[2-4-15 Draft Chapter Drinking Water PAG SHQ grevatt comments.docx](#)  
[ATT00001.htm](#)  
[2-12-15 Draft Chapter Drinking Water PAG.docx](#)

Hi Sam,

Attached are Peter's comments on the version you prepared and the 2-12-15 version that incorporates Eric's comments (but not Peter's).

Lisa

**From:** Grevatt, Peter  
**Sent:** Friday, February 13, 2015 8:18 PM  
**To:** Burneson, Eric; Oshida, Phil; Christ, Lisa  
**Cc:** Clark, Becki; Greene, Ashley  
**Subject:** Fwd: PAG suggested edits

Thanks to the team for all of their work on this. Please see my suggested edits in the attachment for clarity and a few pict questions and comments. Please take a careful look and let me know if any of my suggestions are unclear or in error. Thanks, P.G.

Sent from my iPhone

Begin forwarded message:

**From:** Peter Grevatt <[pc\\_grev@yahoo.com](mailto:pc_grev@yahoo.com)>  
**Date:** February 13, 2015 at 7:39:04 PM EST  
**To:** "[grevatt.peter@epa.gov](mailto:grevatt.peter@epa.gov)" <[grevatt.peter@epa.gov](mailto:grevatt.peter@epa.gov)>  
**Subject:** PAG suggested edits  
**Reply-To:** Peter Grevatt <[pc\\_grev@yahoo.com](mailto:pc_grev@yahoo.com)>

**To:** Oshida, Phil[oshida.phil@epa.gov]  
**From:** Christ, Lisa  
**Sent:** Tue 2/10/2015 1:46:39 PM  
**Subject:** Rads PAG  
2-4-15 Draft Chapter Drinking Water PAG SHQ.docx

Eric and I reviewed the document as well as ORIA management (DD level). The attached document is ready to go to the Radiation PAG inter-agency subcommittee comprised of representatives from EPA, FEMA, DHS, NRC, DOE. We would like to provide it to the subcommittee this Thursday for their review.

~~~~~

Lisa Christ, Chief

Targeting and Analysis Branch

Office of Ground Water and Drinking Water

USEPA

1200 Pennsylvania Ave NW
Washington, DC 20460-0001
phone: 202.564.8354
fax: 202.564-3760

Mail Code: 4607M

To: Hernandez-Quinones, Samuel[hernandez.samuel@epa.gov]
From: Christ, Lisa
Sent: Thur 1/22/2015 3:27:16 PM
Subject: FW: EPA Advice Needed for water guide in July nuclear plant exercise

-----Original Message-----

From: Christ, Lisa
Sent: Wednesday, January 21, 2015 4:13 PM
To: DeCair, Sara; Veal, Lee
Subject: RE: EPA Advice Needed for water guide in July nuclear plant exercise

Hi Sara,

1. The PAG is only guidance/recommendations. States may chose whatever level "fits" their community situation. We are currently working on a proposal for a drinking water PAG. I don't see an issue with SC using the attached guidance with the caveat that the SDWA MCLs are still enforceable standards and are not relaxed for nuclear incidents. A state may chose a PAG level greater than the MCL, however, the water system would be in violation and must issue PE and work to get back into compliance as quickly as possible.

2. At this time, I'm not aware of general consensus on what/how states should use drinking water PAGs. I believe it is a state decision. The "rule" that should apply to drinking water is regardless of the PAG level selected - if it is greater than the MCL the water system is in violation and must take actions to return to compliance ASAP.

Thoughts?
Lisa

-----Original Message-----

From: DeCair, Sara
Sent: Wednesday, January 21, 2015 2:33 PM
To: Veal, Lee; Christ, Lisa
Subject: EPA Advice Needed for water guide in July nuclear plant exercise

Lee, Lisa;

RaJah is probably hoping for a fairly quick opinion or guidance on this interesting question. John Griggs published this Analysis Guide right when we were quite sure the old Water PAG would be in an EPA PAG Manual very soon, in fact he didn't cite the DHS RDD/IND guide's mention of a water PAG instead. He has reminded me that the document doesn't tell you which value to use, just provides considerations for analyzing to various benchmarks between PAG levels and MCLs. I know OW supports this document, but it doesn't exactly constitute clear federal guidance on what to use for a PAG in a nuclear plant exercise, which South Carolina has probably thought about and is asking for help.

The Advisory Team will weigh in, which is good, since it is an area of fuzziness for now. Tomorrow, if we have time, the PAGs Subcommittee might mention this since some of the same people are on both groups. I thought I'd get this in front of you two first, so you can think about what we might say. I am glad to draft an answer including these caveats and help shape the Advisory Team input.

Thanks!

Sara

From: Mena, Rajah [MenaRM@nv.doe.gov]
Sent: Wednesday, January 21, 2015 12:26 PM
To: DeCair, Sara; Dempsey, Gregg D.
Cc: Dixon, John E. (CDC/ONDIEH/NCEH); Sincek, Jeffrey (FDA) ; Smallwood, Karen R; John Aucott (John.Aucott@dm.usda.gov); Sandra Threatt; Pemberton, Wendy; Hunt, Brian; Kraus, Terrence D
Subject: Advisory Team/EPA Advice Needed in Support of Southern Exposure 15

Good Morning,

In discussions this morning with the Public Health and Environment WG the topic of drinking water regulations was raised. The state is presently using the EPA guidance document attached for dose limits with respect to consumption of drinking water. It is our experience that states differ in guidance used in this situation. Some treat water as food, applying the DILs as described in the FDA PAG manual for other food types. Some adhere to the SDWA creating radionuclide concentration limits that will relate to the 4 mrem dose. My questions to you are as follows:

1. Is there an issue with South Carolina using the guidance attached?
2. Is there a general consensus or rule with respect to drinking water which should be applied nationwide?

Jeff,

I don't have your A-Team distribution list so please feel free to forward to the group as appropriate.

Thanks in advance for your help!

RaJah Mena, CHP
Senior Scientist
Remote Sensing Lab - Nellis
National Security Technologies, LLC
Contractor to the United States Department of Energy
702-295-8641 Office
702-630-4948 Blackberry
702-794-6057 Pager
MenaRM@nv.doe.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]
From: Christ, Lisa
Sent: Wed 1/21/2015 9:13:27 PM
Subject: RE: EPA Advice Needed for water guide in July nuclear plant exercise

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Lisa

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Subject: EPA Advice Needed for water guide in July nuclear plant exercise

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Thanks!

Sara

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Sent: Wednesday, January 21, 2015 12:26 PM
To: DeCair, Sara; Dempsey, Gregg D.
Cc: Dixon, John E. (CDC/ONDIEH/NCEH); Sincek, Jeffrey (FDA) ; Smallwood, Karen R; John Aucott (John.Aucott@dm.usda.gov); Sandra Threatt; Pemberton, Wendy; Hunt, Brian; Kraus, Terrence D
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Thanks in advance for your help!

RaJah Mena, CHP
Senior Scientist
Remote Sensing Lab - Nellis
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702-295-8641 Office
702-630-4948 Blackberry
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MenaRM@nv.doe.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Wed 1/14/2015 1:38:54 PM
Subject: RE: Agenda for PAG Subcmte & briefing draft for them
[Water PAG briefing for PAG Subcmte 1-12-2015 lc.docx](#)

A few edits on the briefing paper...

-----Original Message-----

From: DeCair, Sara
Sent: Monday, January 12, 2015 12:24 PM
To: Christ, Lisa; Veal, Lee; Hernandez-Quinones, Samuel; Ellis, Jerry
Subject: Agenda for PAG Subcmte & briefing draft for them

All,

I've made some suggestions and deletions in the attached updated briefing that might work well to get the Subcmte up to speed on what we're proposing. Here is an agenda for the 90 minute call/webinar we have on Jan. 22:

- Introductions (name and agency)
- Run thru briefing on webinar, addressing comments and questions as we go
- Schedule and next steps is the last part of the briefing
- The sum of all PAGs under an imaginary constraint umbrella (I have a graphic I can show on webinar)
- Interaction with Food PAG & specifically the mention of drinking water as part of the diet in FDA guide
- Discuss choice of input assumptions and how we might use FRMAC methods for dose calculations
- Possibly using FRMAC methods for Sampling and Analysis

I know we'll wind up referring to our draft chapter and the group will be interested to get their hands on that. I am sure we'll be ready to share it for their review soon, and should set some realistic time goals for those reviews with our internal OGC/AA-ship and intra-office reviews in mind. This agenda will definitely take the full 90 minutes, and I'm confident it'll be a very productive discussion. Please let me know if you have suggestions for this agenda, or feedback on the briefing paper. Thanks!!

Sara

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
Cc: Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Tue 1/13/2015 5:04:03 PM
Subject: RE: Working at Home Today
[ORIA cmts 1-8-2015 Draft Chapter Drinking Water PAG \(4\) Ic.docx](#)
[Water PAG briefing for PAG Subcmte 1-12-2015.docx](#)

Hi Sam,

When we spoke with ORIA last week, we covered their comments through section 5. Sara did a re-write based on our discussion on sections 1-5. Attached are my additional thoughts/comments/questions on the section's discussed and sections we'll cover tomorrow 6-7. I have posed several questions to you in comment bubbles, so please be prepared to respond during tomorrow's call.

Also, Sara sent a draft briefing (a modified version of the briefing for Stan M.) that we'll discuss tomorrow.

Lisa

From: Hernandez-Quinones, Samuel
Sent: Tuesday, January 13, 2015 8:28 AM
To: Christ, Lisa
Subject: Working at Home Today

Hi Lisa,

I feel well enough that I will try working at home today. It is very likely that I will return to the office tomorrow.

I will send you leave forms for the days I was out on SL.

I will be available today at my home phone number.

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

To: DeCair, Sara[DeCair.Sara@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Mon 1/12/2015 6:11:14 PM
Subject: RE: Agenda for PAG Subcmte & briefing draft for them

Hi Sara,
Thanks for preparing a draft and also sending revisions to the PAG chapter. I'm looking at both today/tomorrow.
Lisa

-----Original Message-----

From: DeCair, Sara
Sent: Monday, January 12, 2015 12:24 PM
To: Christ, Lisa; Veal, Lee; Hernandez-Quinones, Samuel; Ellis, Jerry
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Sara

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
Cc: Ellis, Jerry[Ellis.Jerry@epa.gov]
From: Christ, Lisa
Sent: Mon 12/8/2014 6:07:31 PM
Subject: RE: File Attached
12-4-14 Draft Chapter Drinking Water PAG lc.docx

Hi Sam,

Attached are my comments. Although this has a lot of good information, all of which will need to go into the FRN, we probably need to think about how much of it should be in the actual PAG Manual.

Thanks-

Lisa

From: Hernandez-Quinones, Samuel
Sent: Thursday, December 04, 2014 4:26 PM
To: Christ, Lisa
Subject: File Attached

Hi Lisa,

The most recent version of the file is attached.

Sam

=====

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency

Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"